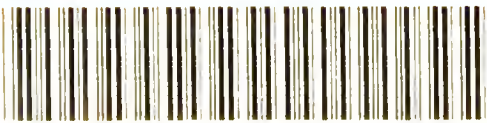


WATER SUPPLY
AND
SEWERAGE
FOR
JERUSALEM

DR. WHITTY.

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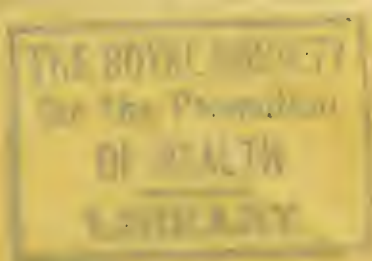


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JERUSALEM FROM THE MOUNT OF OLIVES,
 Taken by permission for this Work from the Photograph taken for
 the Prince of Wales during his tour in the East



FORWARDED

WATER SUPPLY AND SEWERAGE

JERUSALEM

BY

ITS PRESENT STATE AND FUTURE DEVELOPMENT

JOHN LAWRENCE SCOTT,

ESQ.

OF THE

OFFICE OF THE

COMMISSIONER OF THE

WORKS OF THE

CITY OF JERUSALEM

PRINTED BY THE

OFFICE OF THE

COMMISSIONER OF THE

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INTRODUCTION,

BY THE REV. ARTHUR P. STANLEY, D.D.,

CANON OF CHRIST'S CHURCH, AND PROFESSOR OF ECCLESIASTICAL HISTORY IN
THE UNIVERSITY OF OXFORD ;

PRIVATE CHAPLAIN TO H.R.H. THE PRINCE OF WALES ;
AUTHOR OF " SINAI AND PALESTINE," " THE EASTERN CHURCH," " THE
JEWISH CHURCH," ETC., ETC.

6, GROSVENOR CRESCENT, LONDON,

30th August, 1863.

DEAR SIR,

You conveyed to me, some weeks ago, a wish which had been kindly expressed by the Syrian Improvement Committee, that I should add a few words by way of introduction to your elaborate and interesting statement of the present and former condition of the supply of water in the City of Jerusalem.

The Introduction, as you informed me, was to have been written by our lamented friend, Sir Culling E. Eardley ; and you will not expect me to enter into the

subject with the careful detail or the enthusiastic ardour which would have characterised any statement on this subject proceeding from the pen of one who threw himself with such energy into any proposal for the welfare of the Holy Land and its inhabitants.

But I have a melancholy pleasure in availing myself of this opportunity of expressing my admiration for the many excellent Christian qualities that adorned the character of him whom we have lost.

It was my lot to differ from him widely on several important subjects : but for every point of difference we had a point of agreement ; and it was a constant source not only of gratification, but of edification, to meet with one who was so happy in making plans of doing good to others, so hopeful of their ultimate success, and so catholic in the general objects at which he aimed. In no sphere were these qualities more remarkably shown than in his exertions for the welfare of Syria at the time of the war between the Druses and Maronites, and the great Mussulman uprising against the Christian population. He nobly came forward for the relief of those who adhered to branches of Christendom from which he was by his own peculiar views most alienated, and I believe that he never

allowed this alienation of theological sentiment to interfere with his just appreciation of their sufferings or their wants.

In like manner he was drawn with especial zeal towards this proposal for supplying the modern City of Jerusalem with water, because, as you have well said, “neither Greek, Armenian, Latin, Hebrew, or other resident religious community, could find matter of contention against a philanthropic project, designed for their common benefit and enjoyment.” Those who have experienced the painful effect of witnessing the religious divisions of the various communities at Jerusalem will be able to understand how any attempt such as that proposed in the following pages might indeed be regarded as a FRESH SPRING “in a dry and thirsty land where no water is.”

On the topographical and historical interests attaching to the ancient state of the wells and springs of Jerusalem I need not dwell ; but no doubt they invest the whole subject with a sacred halo, which greatly endeared, in the eyes of our departed friend, the benevolent object which he and you had in view. And to myself, an additional motive for complying with your request is that supplied by the pleasure

which it gives me to recall the scene where you first stated to me your views on the subject, in our tents by the Damascus Gate, during the memorable visit* to Jerusalem, in the spring of 1862.

Yours faithfully,

ARTHUR P. STANLEY.

TO DR. WHITTY,
7, Adam Street, Adelphi, London.

* The visit of H.R.H. the Prince of Wales to Jerusalem and the Holy Places, accompanied by Professor Stanley, to whom I explained my proposition for the water-supply and sewerage of the city, as detailed in the body of this work ; especially dwelling on the conservation of the rain-fall, which I have shown to be greatly more abundant than in England ; the deepening of the Well of Joab (En Rogel) ; and the possibility of conveying water through a tube by hydrostatic pressure from Solomon's Pools to the highest portion of the city near the N.W. angle, or to the top of David's Tower, near the Jaffa Gate. (See Chap. II., Sec. 11, and Chap. V., Sec. 5, *et passim*.)

P R E F A C E.

THE subjoined extract, from the columns of an English paper, will serve as an introduction to the subject of the following pages. It contains in a short address the epitome of the entire matter, from which the statements hereafter enlarged upon may be collected at a glance.

In laying this Report before the London Central Committee of the British and Continental Syrian Improvement Association, I regret my inability to do greater justice to the subject, by setting forward the facts in a more interesting form ; I can only assure the Committee that I have spared neither pains or time upon it. The deep interest I take in the improvement of Syria and the Holy City, and the responsibility placed upon me, have been the cause of the expansion of this Report till it has assumed the proportions of a volume ; and if, in my humble endeavour to be of service in the cause, my labours meet with any approbation from the Committee, it will give me great satisfaction.

At first I drew up an estimate for a more copious water supply, but now consider that it would be more

advisable to apply part of the limited funds at present available to the construction of a main sewer.

Nothing has been given but a broad *outline* of what should be performed, which is all that is at present requisite. For the execution of the work more minute surveys will be necessary, and such modifications should be made as occasion and circumstances may require ; but these are mere matters of detail.

In the performance of this task I have been indebted for varied information to the works of Mr. Hughes, Mr. Beardmore, Professor Haughton, Professor Downing, Mr. Dempsey, Mr. Williams, Mr. Thrupp, Lieutenant Van de Velde, Mr. Fergusson, Dr. Robinson, Mr. Neville, Professor Porter, Dr. Pierotti, and others, to whom I acknowledge my obligation.

SYRIA AND THE HOLY LAND—MEETING AT BEDWELL PARK.

(*Extract from the HERTFORD MERCURY, August 30, 1862.*)

“On Wednesday, 30th August, a very numerous meeting was held in Bedwell Park, the seat of Sir Culling E. Eardley, Bart., in connexion with the Syrian Asylums Committee, for the purpose of making public certain facts connected with the late massacre of Christians in Syria, and of raising funds to alleviate, by various means, the sufferings of the survivors of those massacres.

“ There was a numerous meeting, at half-past eleven o'clock, in the Chapel attached to the mansion, presided over by the Bishop of Rochester, when prayer was offered up for the blessing of God upon the land which, in ancient times, was blessed as the spot where He deigned to hold special and intimate intercourse with man, and where the truth once delivered to patriarchs and prophets was preserved.

“ At half-past twelve, the numerous company assembled in front of the house to listen to addresses on the subject of Syria and the Holy Land. The scene was a most interesting one. The weather was extremely fine, scarcely a cloud passing over the blue sky to intercept the fervid rays of the sun. Behind was the house—restored, beautified, and enlarged—a handsome structure of red brick, glowing in the sunshine; before and around, a wide stretch of park scenery, an expanse of undulating green sward, dotted here and there with trees burdened with foliage, sweeping down directly in front of the house to a pleasant piece of water, refreshing to look upon on such a day, and then rising to the wood-crowned heights, which shut in the view; giving to the space over which the eye had leisure to roam the form of a vast amphitheatre, above which rose the monument at Little Berkhamstead, from the summit of which a flag waved triumphantly. In this pleasant spot were assembled a large number of persons, including the representatives of many foreign nations, the Bishop of the diocese, two of the Parliamentary representatives

gave rise to the present movement. One day, in the office of the Syrian Committee in the Adelphi, they received from the Swedish Ambassador a sum of £1,200, from one diocese in Sweden, accompanied by the request that the money might be applied in such a way as permanently to aid institutions in the Holy Land, under Christian auspices, for the relief of orphans, widows, and others, who had been reduced to want during the recent calamity. That sum of £1,200 was, before long, raised to several thousand pounds, by contributions from Sweden chiefly, but also from other nations. The example of Sweden was followed by Denmark, which sent about £1,000 from Copenhagen; by the Protestant newspapers of Paris, which sent about £500; and by the Swiss Protestants, who sent about £500 more. One peculiarity in this was, that these foreign friends sent money to England to be administered by an English Committee; and another peculiarity was that the sums thus sent were accompanied by the expression of a desire that the Institutions to be aided should be Institutions established under Evangelical Christian auspices. This stipulation created some difficulty, for the aid given by their Committee was based upon philanthropy, and the funds were administered by Jews and Christians. Under these circumstances, he felt it to be his duty to go to their treasurer—Sir Moses Montefiore—and to explain to him what had happened; for it was competent for him, and for Baron Rothschild, and Mr. Salomons, and other

Israelites, who were on the Committee, to say, 'This is for a Christian object, and we cannot have it.' The immediate response of Sir Moses Montefiore, however, was, 'This is for Christianity, and for Christianity it must be accepted. You can't, however, expect us Jews to administer it. At the winding up of our Committee it shall be handed over to a Christian Committee to be appointed for that purpose.' At the closing meeting of the Fund, a Christian moved, and a Jew seconded, a resolution to the effect that the money should be handed over to a Christian Committee; and it was the Committee thereupon constituted that had called this meeting together. The President was the Earl of Chichester, and the Vice-President Count Platen, late Ambassador Extraordinary and Minister Plenipotentiary to the King of Sweden. The Committee began to apply the funds placed at its disposal in various ways: It gave £200 to the Deaconesses' Institution at Kaiserswerth, on the Rhine, which had established houses for the reception of the female children of the sufferers by the massacres in Syria. It also gave money to the Order of the Knights of St. John of Prussia, a most interesting institution, the heir and representative of the old Knights of Malta. When that order was dissolved, it was formed into two parts, the Roman Catholic section having its centre at Vienna, and the Protestant at Berlin. The Grand Master of the Protestant section was His Royal Highness Prince Charles of Prussia; the Secretary, General Count Bismark Bohlen;

and the members of it, Protestant noblemen of Germany. The money given to the Knights of St. John had been sent by the two Secretaries to Beirût, with instructions to buy land for an Hospital, which was now in course of erection, or about to be erected. One of the objects the Committee designed to aid was that Hospital at Beirût. The English Bishop of Jerusalem had received two or three grants from them, and grants had also been made to an Institution formed by some friends at Basle for orphans. Mrs. Thompson's Industrial Institution at Beirût for women and children had also received successive grants. One of her establishments—in which 200 women were taught to sew, and also received instruction in the Gospel—was visited by the Prince of Wales during his stay in the Holy Land. And now, without dwelling further on the way in which the Committee had spent part of the money placed at its disposal, he (the Chairman) would proceed with another part of his statement. At an early period some of the Committee were deeply impressed with the idea that God had not sent them this sum of money to be at once spent, and the account closed. They felt that, having come to them in so remarkable a way, it was intended as a sort of nest egg—as the nucleus of a larger sum, to be applied to the permanent assistance of such institutions as those to which he referred. They therefore determined to test the willingness of the Protestant Christians in those countries from which contributions had been received, as well as in other nations, to form

a permanent fund. Consequently, they invited Mr. S. to visit the Countries from which the greater part of the funds had been obtained. He attended a great annual gathering of the Scandinavian nations, at Christiana, in Norway, and there found a universal response to his appeal in behalf of making the fund the nucleus of a larger one. He next visited Germany, and was there received with the same unanimity. The people said, 'If you establish a good scheme, we will give you a sort of Peter's pence in aid of it.' In Sweden the answer was the same. They had a Conference of the Evangelical Alliance at Geneva last autumn, when the following resolution was agreed to: 'The Christians of various Countries and Churches, assembled in conference at Geneva, desire to express their profound sympathy with the populations of Syria, so painfully tried by the massacre with which they were last year visited. They rejoice at the plan proposed by British Christians to make the London Syrian Committee a Central Committee; and they express the wish that the Committees which in Syria and the Holy Land have undertaken special efforts, may place themselves in connexion with the Central Committee of London, either directly or through the medium of the different branches of the Evangelical Alliance, for the purpose of concentrating their efforts, so that the beneficial influence of Evangelical Christianity and the true progress of civilisation may be more widely and more securely extended in those countries.' It being thus the opinion of their brethren, up

and down Europe, that they should create a central fund for the objects stated, they determined to seek general contributions. But before they could apply to people of all ranks to help them in their work, it was necessary that they should be prepared to submit a business-like plan, and one that would bear examination, to their friends. Accordingly they put themselves into communication with Lieut. Van de Velde, well known as a writer, and as the best hydrographer of the Holy Land—a man distinguished for his scientific attainments, and who had offered his services. Lieutenant Van de Velde was coming to England for the purpose of receiving instructions, when he (Sir Culling Eardley) met him by appointment at Geneva, at which place it was determined by himself and others to recommend the Committee to employ Mr. Van de Velde to go out to Syria, together with the Chevalier de Novina, a young Polish nobleman. They went out together, and spent the last winter in Syria. Mr. Van de Velde had ascertained the number of persons widowed and orphaned by the massacres, and had prepared a scheme of work, which had been more or less modified by the London Committee. Now there were three principal things which the London Committee proposed to help on. One was the effort undertaken by their American friends, who were the most successful workers in the Turkish Empire, and one of whom, he was glad to say, was here to-day. He believed he was speaking the judgment of every man

who knew Turkey—from Lord Stratford de Redcliffe, Sir Henry Rawlinson, Mr. Layard, and Sir Fenwick Williams, down to the humblest traveller in the East—when he said that the American Missionaries were the most successful workers in the Turkish Empire. And he would mention one of the features of their working. Their great object was to influence the Christian population, in the hope that, by elevating them, they might also elevate the Mohammedan population. Their American friends were, in a great proportion, non-Episcopalians—in other words, they were, for the most part, Presbyterians, Independents, or Methodists—while the Churches of the East were, without exception, Episcopalian. But the American Missionaries never uttered a word on the subject of Church order; they never expressed an opinion antagonistic to the Episcopalian form; they never attempted to set flocks against their pastors. What they endeavoured to do was, to propagate the common faith, and in the doing this not one word of sectarianism had ever fallen from their lips. This did them great honour. It was also honourable to them that, afflicted as America was by the terrible struggle that was going on in the States, they were nevertheless putting their shoulders to the wheel to promote the education of the young men of Syria in the doctrines of the Gospel. One of their objects, then, was to assist the American effort for founding a College for the education of the young men of Syria. Another of

the objects of the Committee was to assist the Deaconesses' Society at Kaiserswerth to establish Deaconesses' houses throughout Syria, for the education of the female population; and he might mention that Miss Nightingale* had written to him a very interesting letter on that subject, urging upon the

* "9, Chesterfield Street, April 8, 1862.

"Dear Sir Culling Eardley,—Your former kindness encourages me to apply to you again on behalf of our friend Pastor Fliedner and his Syrian establishments, to which you will remember your Society was good enough to send £200 last year, which really saved them almost from being shut up. They are now in great straits again. At Beirût they have built an Orphanage, in which the Deaconesses live with 97 orphans, soon to be increased to 120. And this very month, in the same building, the School for the daughters of the richer Arabs and European merchants begins. Even from Roman Catholic families they are about to receive girls into this School. It was so impossible to find a healthy house in Beirût that the building was absolutely essential. But it has left them under a heavy load of debt. Kaiserswerth has to pay 1,000 thalers immediately, in addition to 7,000 paid before, and in addition to the current expenses of the 97 orphans and 12 widows, also borne by Kaiserswerth.

"One would never have expected from theory that these plain North German Deaconesses would have united such singular aptitude for the Eastern work with their devoted earnestness. But so it is; and from my experience of them, I believe that none do it so well.

"If your Syrian Committee can do something to help these good Kaiserswerth people, I would gladly on my part do what I can in sending them money. I know nowhere where a little money does so much.

"Believe me, dear Sir C. Eardley,

Yours faithfully,

"FLORENCE NIGHTINGALE."

Committee the importance of supporting this plan of Pastor Fliedner. There was also the order of the Knights of St. John of Prussia, who were building an Hospital at Beirût, which they purposed to assist. Besides these three principal objects, there were the works of the Bishop of Jerusalem in and about Jerusalem, the labours of Mrs. Thompson, and other subsidiary objects. This, then, was his contribution to the information to be afforded to the meeting to-day. (Cheers.) Having laid some evidence before them, he must be allowed, as counsel for the plaintiff, to ask them, when the time came, to give a verdict in his favour. It was a glorious object to do good. To do good to man's body—to give a poor famished man a piece of bread and cheese—was to do a good thing; but when, in addition to this, we gave a man the Bread of Life, we conferred upon him a double blessing, and did an act which was doubly to be praised. And what a glorious thing it was to do this in the land of Syria—of Israel—to do the same thing that Jesus Christ did in that country; for it was written of Him that He went about doing good. (Cheers.) They were now called upon to help, and had an opportunity of helping forward a movement which would take them in the very footsteps of the Saviour. He could not conceive of a movement which was more worthy of the support of the philanthropist, and of the Christian, who was more than a philanthropist. He was now looking out on two flags—one was the flag of the nation; the other was the Bethel flag. The one had floated over

many a gallant vessel, and witnessed many a gallant deed done in defence of England ; the other had stood over many a tent, and in the midst of many a gathering where the Gospel of peace was proclaimed. It had been said of the one that it had 'braved the battle and the breeze' for 'a thousand years;' it was true of the other that it had been the symbol of our faith for nearly 2,000 years, and would be for ever. (Cheers.) One flag they had raised in honour of their country, the other in honour of their Saviour; and in the presence of these emblems of the country's strength and glory, he asked them to give their verdict to-day in favour of the enterprise which he had explained to them. (Loud cheers.)

"The Rev. Professor Porter and M. Jules Ferrette then addressed the meeting, and described the calamities of the late massacre ; after which the first resolution, approving the plans of the 'Syrian Asylums Committee,' was moved by the Bishop of the Diocese, and seconded by the Rev. W. Griffith, Independent minister, of Hitchin. The next was moved and seconded by Abel Smith, Esq., and Giles Puller, Esq., Members of Parliament for Hertfordshire. The third resolution was sustained successively by the Swedish Secretary of Legation, and by Protestant pastors from Germany, Holland, Switzerland, Italy, and America. It appeared, from the narrative given to the meeting, that about £7,000 had been contributed, by foreign countries, to the 'Syrian Relief Fund,' specially for Christian asylums in Syria and the Holy Land.

This sum had been made over by the Committee of that fund to a 'Syrian Asylums Committee,' constituted for the purpose. Many persons, it now appeared, at home and abroad, were desirous to add to the amount; and it was in prospect to apply all these resources to subsidising various schemes of philanthropic Christian usefulness in Syria, initiated by England, Germany, and America respectively.*

"At the close of the meeting, about two hundred guests were entertained at a luncheon in the New Picture Gallery. Sir Culling E. Eardley presided, supported by the Bishop of Rochester, Mr. Giles Puller, M.P., Mr. Abel Smith, M.P., &c. After the repast,

"Sir Culling Eardley rose, and said he had reserved until now another subject, distinct from the purely Christian object of the public meeting—viz., *the question of the supply of the City of Jerusalem with water*. At the breaking up of the Syrian Relief Fund, there was a sum of some thousands of pounds in hand, and after paying £5,000 to the Christian Asylums Committee, the balance was handed over to an Improvement Committee which was appointed, in whose hands there now remained a sum of £3,000. The Committee was seeking for a proper object for the application of these funds. Inquiries had been made as to whether it was not possible to

* Since the meeting these plans have been considerably matured.

supply Jerusalem with water ; and as they had now present a Civil Engineer, Dr. Whitty, who had prepared a plan, he would (without prejudging the question whether such would be the best possible application of the money) call upon him to state his views.

“Dr. Whitty then spoke as follows :—The immortal interest attaching to the CITY OF GOD, from its Sacred-historic associations, will naturally elicit attention to a proposal for the benefit of its present inhabitants. Jerusalem, once the CITY OF THE GREAT KING, and hereafter to be *The Joy of the whole Earth*, is notoriously, at the present period of its degradation, rendered insalubrious and defiling to the senses by the absence, comparatively, of water. The consequences of such a privation to a large population, in a torrid climate, surpass any description.

“Situated as the city is on the summit of a table rock of limestone, surrounded on three sides by precipitous glens, down which the rain pours in temporary streams during winter showers ; no rain-water can remain thereon, save that which may be caught by artificial means, and retained in cisterns. The glens in a short time drain the arid height, and the streams then cease to flow.

“How inadequate to the requirements of a civilised population is the present supply of water in Jerusalem, and how noxious is the quality of a portion of it, I shall point out, whilst I suggest a tangible remedy.

“Lieutenant Van de Velde, of the Dutch Royal Navy, having been commissioned by the Syrian Asylums Association to collect information on the condition of Syria after the late massacre, deputed me to proceed to Jerusalem, and report upon the feasibility of sinking an Artesian well within the walls, or otherwise the best mode of supplying the city with water.

“The sinking of an Artesian well is utterly out of the question. The geological structure of the district is against it ; and no water could be obtained by that means.

“But to the question, Can a sufficiency of water be, by any means, obtained ? I am in a position to give the desired and most decided answer. Having spent several weeks in making the necessary observations, and in minute personal inquiries into the existing conditions of supply, and the sources whence a further supply might be derived, I can lay the following statement before this meeting :—

“The present supply of the city is derived chiefly from two sources—first, Rain-water, which, falling copiously during the winter season, is to a limited extent collected in cisterns within the city, and retained for household purposes ; second, Wells in the Valley of the Kidron, outside the city ; which yield impure water, impregnated with organic salts and other soluble deleterious matter.

“As no effective sewerage system exists for the town, it may be easily imagined whence arise the

notorious unhealthiness, the unsavoury odours, and the filthy defilements of the place.

“The cisterns are almost invariably vaulted chambers beneath the dwellings, *and are in most cases only separated from the common cesspools by cemented walls, and neither cisterns or cesspools are often cleansed.*

“The wells in the Valley of the Kidron, before mentioned, are two in number. The first, called the Fountain of the Virgin, in summer time—save during its well-known intermittent flows, which phenomenon has not yet been accounted for—derives nearly all its water from the leakage of the tanks and cesspools in the city, and the water thrown out from the dwelling-houses; from this well a channel tunnelled in the solid rock conducts the outflow to the Pool of Siloam, about 400 yards distant. At this place all the clothes of the poor in the adjoining village of Siloam are washed; and the water then enters a small tract of vegetable gardens, called in Scripture the King’s Gardens, and having been divided into small streams for irrigation purposes, becomes absorbed in the ground, and, sinking through the soil, is again partially collected in the Well of Job adjoining—being the second well in the Valley of the Kidron, and which, but for this tainted source, would be frequently quite dry in summer.

“All the water which it can yield at one season of the year, which is but little, is carried back to the city in goatskins, to supply an unwholesome beverage to

those who have no tanks beneath their houses, or whose cisterns may have become empty.

“Such a condition of things, with regard to an element so essential to human life, comfort, and cleanliness, is appalling to contemplate. How fearful must be the amount of disease and misery arising from it ! Is it capable of remedy ? and from what sources can it be realised ? I proceed to specify them :—

“First.—Internal : Means might be adopted for collecting the rain-fall of the city over and above that at present diverted into the private tanks of the dwellings. I have made calculations as to the amount of water likely to accrue from this source, but it is unnecessary to enter into figures in this abstract ; in my lengthened Report on the subject I have given full particulars.

“Second.—External : There are also two external sources from which the city might be supplied with water. The first of these consists of the elevated land to the north and north-west of the Damascus Gate ; the summit and sides of the Mount of Olives and other tracts of country ; which, by a proper arrangement of channels to intercept the winter rain, and prevent it flowing off into the valleys, would yield sufficient surface water to supply the Pools of Bethesda and Hezekiah, &c., within the city ; and also a large tank near the Damascus Gate without the city ; the water of which last-mentioned tank I propose reserving exclusively for the flushing of the sewer, which I suggest to be made through the city from

north to south in the depression formed, at least in part, by the Tyropœon Valley,* into which lateral sewers should be opened.

“The second external source from which water might be procured is the Pools of Solomon, about seven miles distant, by simply repairing or reconstructing one of the existing aqueducts. A portion of the water might be allowed to flow off at Bethlehem for the use of the inhabitants of that village, and the remainder would constitute a running stream in Jerusalem, which would likewise benefit the village of Siloam.

“The expense of the water supply I have estimated at £5,504 6s. 8d. (exclusive of the cost of the sewerage system, which is a separate matter, but one which I also recommend as a sequent).

“It may now be seen how, by a small application of means, a benefit of the highest kind, and open to no

* It has been, and is, a matter of controversy whether the depression from the Jaffa Gate, or that from the Damaseus Gate, towards the Haram, is portion of the true Tyropœon. Mr. Thrupp, late Fellow of Trinity College, Cambridge, and author of “Antient Jerusalem,” in a letter I lately received from him, says, “My own belief is, that neither is entitled to the name; but that the Tyropœon (properly so called) begins where the two unite.” I shall, therefore, distinguish the depression that runs eastward from the Jaffa Gate by the name of David Street Valley, the street through it having been named after King David by the Crusaders; and the depression that runs north and south from the Damaseus Gate to the Mughâribeh, or Moor’s Gate, called by Franks the Dung Gate, by the name of Mill Valley, by which it is known; there being in it a number of oil-presses, or mills for olive berries.

possible objection from the very disinterestedness of its nature, can be accomplished. What more permanent boon, of a temporal kind, could be given by the philanthropy of Europe, to a city to which itself owes so many higher obligations ?

“Jealous as the Turkish Government ever is to grant concessions for commercial projects, through the fear of political ulterior complications, by favouring English over French or Russian interests ; here at least, no such opposition need be expected ; the Koran itself enjoins ‘personal cleanliness,’ and the humanity of the Moslem digs wells and erects fountains, that the poor may have water without price !

“I had an interview lately with the Grand Vizier* at Constantinople. It is his desire to improve Syria by the formation of roads, aqueducts, &c. ; but he told me the present state of the treasury put it out of his power. I have, therefore, no doubt that, if this association would supply the means of carrying out this benevolent work in Jerusalem, he would be only too glad to grant a Firman, conveying the requisite authority.

“Neither Greek, Armenian, Romanist, Hebrew, or other resident religious community, could find matter of contention against a philanthropic project, designed for their common benefit and enjoyment. England, France, Russia, with their respective establishments in Jerusalem, could, in this good object, only see cause for co-operation and liberality.

* His Highness Fuad Pasha.

“Lastly, as all common sympathies were recently blended in one common and harmonious course of philanthropic action in behalf of suffering Syria ; now, as a fitting termination of labours, and a happy application of any balance remaining ; can a better plan of permanent relief be proposed than this of making Jerusalem, whence ‘living waters’ have flowed for the ‘healing of the nations,’ to be itself a *place of fountains*, fresh, and flowing with health, comfort, and purity ?”

“Pliny states that Jerusalem was the most famous city, not only of Palestine, but of the whole East. The conclusion, therefore, follows that it must have been well supplied with water, or it could never have risen to any great degree of importance. Strabo, Josephus, the Holy Scriptures, and the concurrent testimony of all historians who wrote upon the subject, inform us that it was abundantly supplied with water.

“During all the sieges which it underwent, though the inhabitants were frequently driven to the last extremity by hunger, we read but on one occasion of their having experienced any inconvenience through a deficiency of water ;* and we know that the minimum

* In the 161st and 162nd Olympiad, when Antiochus besieged Jerusalem, Josephus states that the Jews “were once in want of water.” (Antiquities xiii. ix.)

The following extract from Ezekiel, prophetically describing the state of the city during the first siege by the Chaldeans, intimates that there should be a scarcity not only of bread, but of water also, within the walls : “Moreover he said unto me, Son of Man, behold

quantity which would, with the utmost economy, support life during a protracted siege in the population of a city much larger and more densely inhabited than the present, such as the ancient city is described to have been, must have vastly exceeded the scanty supply which we find within the walls at the present day; and such inquiries as these naturally suggest themselves—How comes this deficiency? By what means could the city have been formerly supplied more copiously than now? Can the source of that additional quantity be again discovered? Have recent changes taken place in the geological structure, physical geography, or the climate of Palestine, such as could have withdrawn from the land large quantities of water formerly available for the service of its chief city? If no hydrographical change can be proved to have taken place, if no alteration has occurred in the contour of the hills and valleys, if the material of the rocks and the composition of the earth's crust have remained the same, and, save the denuding of the hills of timber, if no natural cause of any kind appears why there should not be as much moisture in the land now as formerly—are we not justified in asserting that, provided the same means which *once* had been successful, were again adopted

I will break the staff of bread in Jerusalem: and they shall eat bread by weight, and with care: and they shall drink water by measure, and with astonishment: that they may want bread and water, and be astonished one with another, and consume away for their iniquity." (Ezekiel iv. 16—17.)

to collect and convey the moisture, Jerusalem, practically speaking, might be supplied with water now as abundantly as at any previous period of its history, in its proudest and its happiest days ? ”

To these and similar considerations I have directed my attention, and shall briefly set down the result of my surveys and investigations, hoping they may lead to the expected blessing.

When a dispassionate consideration shall have been given to the several subjects enumerated in the Table of Contents, the conclusion must force itself upon every mind, that, by a comparatively small outlay, a vast benefit might be rendered to Jerusalem, by bestowing on it an efficient system of sewers, and an adequate supply of water.

And in carrying out this beneficent object, both Christians and Jews throughout the whole world ought cheerfully and strenuously to unite. Jerusalem has an equal claim on both. It is the metropolis of Christendom, and the metropolis of the Hebrew nation. It is the scene of Christ's suffering, and it is “The city of David ;” * “The city of the Lord,” † whom both adore ; “The Zion of the Holy One of Israel,” ‡ who “hath desired it for his habitation.” || “Is he the God of the Jews only ? is he not also of the Gentiles ? Yes, of the Gentiles also.” §

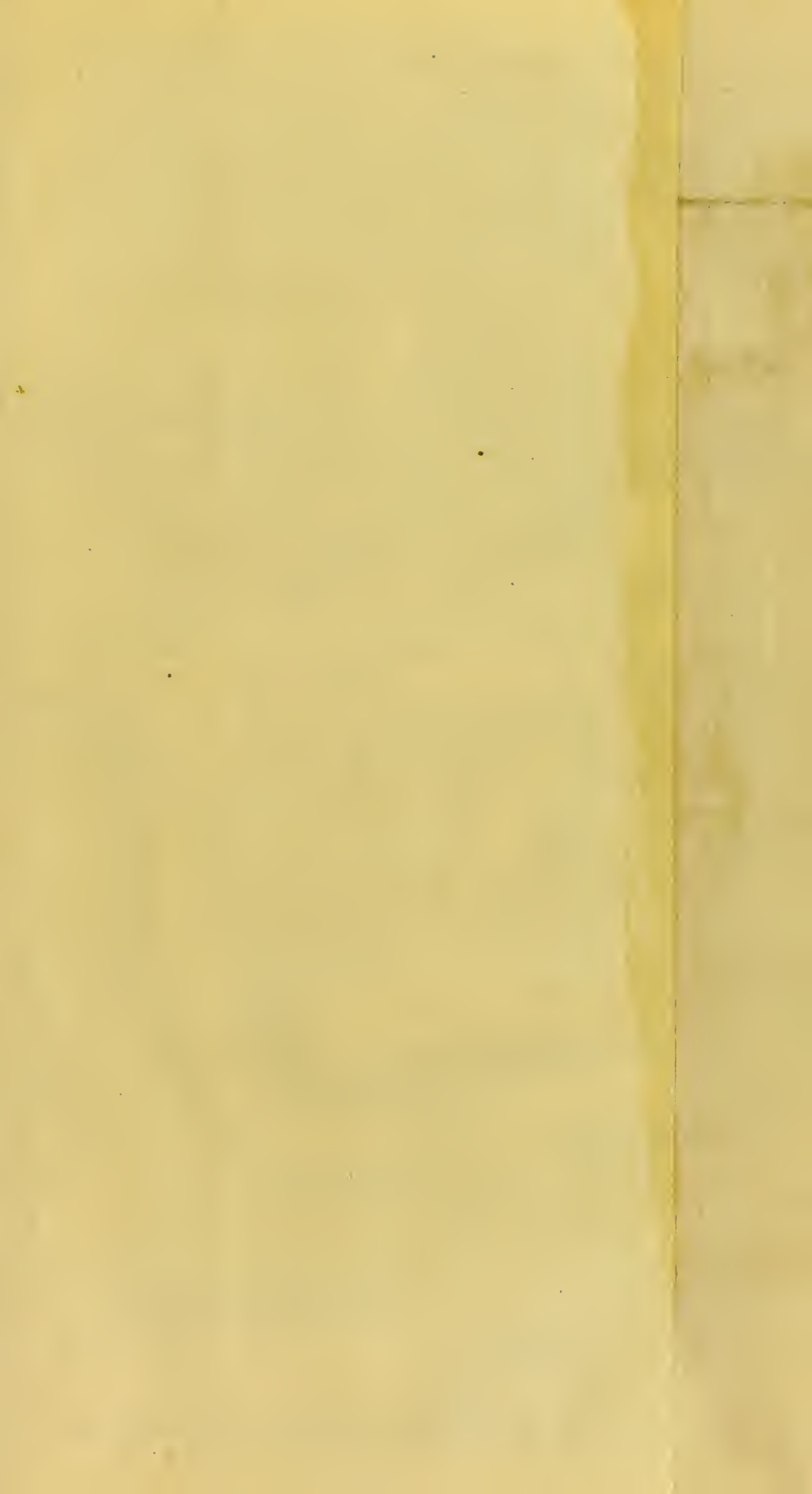
* 2 Sam. v. 7.

† Isa. lx. 14.

‡ *Ibid.*

|| Psa. cxxxii. 13.

§ Rom. iii. 29.



PROPOSED WATER SUPPLY AND SEWERAGE

FOR

JERUSALEM.

CHAPTER I.

SECTION 1.

EXTENT AND POPULATION OF THE ANCIENT CITY.

The limits of the different areas that the ancient city of Jerusalem occupied at various periods can now be but approximately determined. During the reign of Solomon, when at its highest point of glory—whilst the trade with India enriched its treasures—the city covered scarcely more ground than it does at present, for though at two points it extended further towards the south, its northern limits were far within the present boundary.

Even that which has been known as the “second wall,” subsequently built in part by King Hezekiah, and partly by Manasseh, when they enlarged the circuit of the city towards the north, in the opinion of

many commentators, did not include the site whereon stands the Church of the Holy Sepulchre, which lies 223 yards within the present wall, towards the north-west; whilst at the north-east, though it extended a greater distance, it still, in the opinion of most topographers, lay within the modern city boundary.

It is probable that the walls destroyed by Nebuchadnezzar, and restored by Nehemiah, coincided in position with those in Christ's time, with the exception of some small alteration made by Herod the Great, near the Fortress of Antonia, at the N.W. corner of the Temple enclosure.

About ten years after the death of Christ, and before the destruction by Titus, the walls attained their greatest extension. The city having long outgrown the limits of the first two walls, a third was added, which was commenced by King Agrippa the Elder, under the Emperor Claudius Cæsar, and subsequently completed by the Jews themselves. Of this, called by Josephus the "third wall," but few traces have remained to modern days to enable us to identify its position, save at the N.W. corner; and these remnants of the foundation are now partly obliterated, in the erection by the Russians of extensive walled-in buildings and premises on ground lately acquired by

them, shown upon the Map.* The line of its extension towards the N.E. and on the E. is somewhat conjectural, but I shall adopt that on the side of which probabilities appear to preponderate.

Commencing about 300 yards N. of the N.W. angle of the city, and running northerly for 350 yards ; then eastwardly and nearly parallel to the present wall for about 260 yards, the foundations, evidently of this "third wall," are, or were till recently, traceable for a total length of nearly 610 yards. It then probably continued eastward, in a more or less direct line, to the Valley of the Kidron, and then swept southward along its course, enclosing the Temple Area, and the eastern suburbs of the City.

We read in Josephus that the Wall of Agrippa "passed by the Sepulchral Caverns of the Kings."

* The commanding position of this strong enclosure is very significant. It occupies higher ground than any portion of the city ; is more than 21 acres in extent, and only 140 yards from the city wall. Within is a Cathedral, and other buildings, shown upon the Map. The walls surrounding it are massive and very lofty ; and, altogether, it is constructed on such a scale as to be capable at any moment of being converted into a formidable fortress. It resembles, in outward appearance, the enormous Convent, called the Convent of the Cross, less than one mile and a quarter distant ; likewise built under Russian auspices, and calculated to accommodate 3,000 people ; and which, from a distance, would be mistaken for a powerful auxiliary fortress, by any one uninformed as to its religious meaning.

(Jewish Wars, v. iv., 1, 2.) These, in common with Williams, Thrupp, Barclay, Robinson, and others, I take to be the sepulchral caverns, or Tombs of the Kings, so called at this present day, 800 yards due north from the Damascus Gate ; but Pierotti, Lewin, and others, take them as identical with the great subterranean quarries beneath the city, named Cotton Megara, the entrance to which was only recently discovered under the foundation of the wall, seventy yards east of the Damascus Gate. M. Van de Velde also—during our voyage homeward together from the East—told me that, since his last visit to the place, he looked upon Cotton Megara as, not impossibly, that which Josephus mentions under the appellation of the Royal Caverns ;* and this circumstance, together with indications of an ancient fosse and heavy rabbeted

* I made a survey of these caverns, kindly assisted in the work by some gentlemen connected with the Anglican Bishopric. The entrance is by a small hole under the foot of the city wall, through which it is necessary to creep on hands and knees. The general direction of the caverns is S.E., directly towards the Pasha's residence, called the "House of Pilate," at the N.W. angle of the Haram ; and it extends nearly half the distance between the city wall and it ; running, so far, nearly parallel with the street along which I have proposed making the main sewer—but not beneath it—to ascertain which was the chief object of the survey. An account of the discovery of this cavern by Dr. Barclay, and a good description of it, is given in his "City of the Great King" (pp. 458 to 468.)

masonry, improperly called bevelled, characteristic of Jewish or Roman origin, appearing along the wall in various places, commencing a little westward of the Damascus Gate, induce them to suppose that the Wall of Agrippa, the third or outer wall of the ancient city, corresponded with the position of the present wall, at least from the point above mentioned, west of the Damascus Gate, as far as the N.E. angle; from whence southward, till it joined the Temple enclosure, they conclude it could not have deviated far from it, because of the adjacent declivity of the Valley of Jehoshaphat.

Assigning as the limits—which I shall show grounds for presently—the line represented in the characteristic of my boundary on the accompanying Map, the outer wall, at the N.W., lay in a line, varying from 850 to 950 yards beyond the probable position of the second wall—that built by Hezekiah and Manasseh—and from 400 to 670 yards outside the present wall, enclosing a space of about 822,161 square yards not now included.

There are also two other spaces excluded by the modern wall, which, according to the boundary assumed, belonged to the ancient city: one containing about 76,298 square yards, at the east, upon the

verge and declivity of the Kidron; and the other about 389,243 square yards, at the south. This latter portion consisted of the southern brow and slope of the modern Mount Zion* and the southern slope of Mount Moriah, which was denominated Ophel.†

SPACES IN ANCIENT CITY EXCLUDED BY THE MODERN WALLS.

Locality.	Square Yards.
North of City . . .	822,161
East, by the Kidron . .	76,298
South, upon Zion and Ophel .	389,243
Total . . .	1,287,702

These quantities make together 1,287,702 square yards, or 266 acres and 262 square yards, being 255,554 square yards, or $52\frac{3}{4}$ acres and 244 square yards more than the space within the circuit of the modern city walls, which includes 1,032,148 square yards, or $213\frac{1}{4}$ acres and 18 square yards. Adding these quantities together, we find, on the best evidence we can obtain, the ancient city to have com-

* For distinction between Ancient and Modern Zion, see Appendix, No. V.

† Mr. Thrupp supposes Moriah, properly, not to have been the appellation of an individual hill, but of a district; and Ophel not to have been the southern slope of the Ancient Mount Zion, but a building thereon. (See Thrupp's "Antient Jerusalem.")

prised 2,319,850 square yards, or $479\frac{1}{4}$ acres and 280 square yards, which gives a datum upon which to found our calculation.

TOTAL SPACE OCCUPIED BY ANCIENT CITY.

	Square Yards.
Extent of the present City .	1,032,148
Space outside the present Walls, included in the Ancient City	1,287,702
Total	2,319,850

We have thus arrived at the probable extent of the ancient city ; and to confirm the view, Josephus asserts that the circuit of the city was 33 stadia, which is the precise length of the boundary I have laid down.

Josephus so distinctly states that the length of the outer walls of the city was 33 stadia,* that I cannot conceive for a moment we are at liberty to adopt a line which would give any other measurement ; at least, we should not be justified in doing so, without the very *strongest* evidence in favour of it, and against the

* The stadium was a Greek measure of length, equal to 606 9-10 English feet. It contained 125 geometrical paces, or 625 Roman feet, and corresponded to a furlong.

accuracy of his statement. Though he might sometimes err in respect to altitudes and calculations of distances not accessible or easily made, so plain a matter as the length of the boundary of a fortified city could not have been unknown to an intelligent inhabitant; especially to a soldier, a historian, and one who had given special attention to the topography of the place.

Upon the Map I have shown the several conjectural courses of these outer walls, as fixed upon by some of the most eminent writers. It is to be regretted that all the principal authors who treated on the subject did not actually visit Jerusalem, and for themselves examine the locality. I, having been lately there, have had the advantage of all their labours and research; and having studied each author separately, upon the very ground itself, and walked over it repeatedly—a separate time for each authority, with his work in my hand—I arrived at the conclusion that one may be right in one point, and another in another point; and, whilst I agree with none as to the complete circuit of the walls, I have adopted suggestions from all; and each point on the course of my boundary will be found to coincide nearly, or identically, with some one or other of theirs.

Commencing, therefore, upon the broad principle that the walls must be in any case 33 stadia in length, I am borne out by all commentators in taking the eastern wall of the present city as standing upon part of the line of the ancient wall. Thus far there is no difficulty.

From the N.W. corner of the present wall, I closely follow the boundary of Mr. Williams and Mr. Thrupp, to the N.W. angle of the new Russian acquisition, and then the northern boundary which they suggest, for 300 yards ; then mine deviates from theirs, not approaching so near the Tombs of the Kings, but continuing in a straight line ; which I think more in accordance with the words of Josephus. At about 550 yards from the point of deviation it again falls in upon Mr. Thrupp's line, and at about 170 yards further upon that of Mr. Williams ; from which to the N.E. bending, our three lines approximate to each other, and do not diverge widely from that of Dr. Robinson. Upon the East, my boundary, till opposite the northern wall of the Haram, runs nearly parallel to that laid down by Dr. Barclay, but does not lie so low in the valley. Then from near the Golden Gate to the southern point of Ophel ; from whence my boundary turns westward for 100 yards, running nearly

parallel to that of Mr. Williams, and crosses the mouth of the Tyropœon.

It then unites with the boundary shown in the first French edition of Dr. Pierotti's map, excluding the Pool of Siloam ; and, turning eastward, follows his boundary till, at a distance from the pool of about 105 yards, it unites again with that of Dr. Barclay, from which point to its termination at the S.W. angle of the present city wall, both their lines coincide closely with mine.

Thus it may be seen along the whole course of the boundary ; which having given the subject much consideration, I with confidence suggest as, at least, approaching to the true one. I am borne out in each separate portion by one or more of the principal authorities in the matter ; excepting that portion upon the north, where I have straightened the course, by cutting off a large projection, included by Mr. Williams, and partly also by Mr. Thrupp.

That objections may not be raised against placing the boundary on the east and south so low in the valleys, and near the base of the hill, on the ground that the slopes thus included are too steep to have been ever built upon, I may mention that Aristæas, who was sent by Ptolemy Philadelphus on a mission

to the Jewish High Priest, describes the city as "situated in the midst of the mountains, on a lofty hill, whose crest is crowned by the magnificent Temple, girt with three walls, seventy cubits high, and of proportionate thickness, and length corresponding to the extent of the building." He says that the city was built on the declivity of a hill : its streets had raised pavements for passengers purified at the Temple, whilst others walked below ; some of the streets ran along the brow of the hill, others lower down, parallel with the course of the valley, connected by cross streets. And I refer near home to the houses in the old town of Edinburgh, which are built on declivities quite as steep ; and, in Syria ; to Safed, Samaria, and Joppa, or as it is now called Jaffa. In the latter town I have ridden on the little Arab horses, up and down flights of from six to ten stone steps, of which part of the public streets consist, as steep as those at the Duke of York's Column, in London. Some of my readers, no doubt, have been in Jaffa, at which steamers to Beirût and Alexandria frequently stop, and have seen what I describe ; they are far more precipitous than those at Valetta, in Malta, which Lord Byron characterises as "streets of stairs."

Here I may mention, that my uncle, the late General Whitty, was for many years previous to 1848 in command of the Troops and Garrison at Malta. It was his presence in the Mediterranean, and correspondence from thence, that first drew my attention steadily to the East, and awakened my sympathies for the Holy Land.*

Safed, the position of which is not unlike that of Jerusalem, in the words of Professor Porter, "is situated on an isolated peak, which rises steeply from the southern brow of the mountain range. A deep glen sweeps round its northern and western sides, and a shallower one, after striking the eastern side, falls

* The following notice of his death appeared, October 6th, 1855 : —"MAJOR-GENERAL WHITTY.—Died, on the 2nd October, Major-General Irvine Whitty, on retired full pay from the Royal Artillery, in which corps he had served since the year 1805, having been appointed Second Lieutenant on the 12th July in that year. General Whitty was present in the following actions: Reduction of the Danish Islands in the West Indies, in 1807; capture of Guadaloupe, in 1810; was attached to the army of reserve, in support of the force engaged at Waterloo. He received the war medal and two clasps. Aged sixty-seven."

It gives me pleasure to remember that I was so nearly related to one who spent his life in the service of our country, and that his eldest brother, Edward, Captain in the 32nd Regiment, also did service to his country, being killed in action, at the age of twenty-one, on the memorable field of Waterloo.

into the former a few miles to the south. The old castle crowns the peak ; the Jewish quarter of the town *clings to the steep western side* considerably below the summit ; the rows of houses *looking at a distance like stairs.*"

On the eastern slope of Mount Lebanon I slept in a village near Zahleh, in which, for a great portion, there are no streets or passages whatsoever, between the several rows of houses : which being built contiguous, and in steps one above the other, the flat earthen roofs of one row serve as a landing-place, or street, so to call it, in front of the adjoining parallel row of houses ; the roofs of which in their turn, serve as a street for the succeeding row on a higher level ; and so on successively. Many towns and villages throughout the country are built on the same principle. In Jerusalem itself, at the present day, there is an example of the kind : Over a portion of the so-called *above-ground* buildings attached to the Church of the Holy Sepulchre—as distinguished from various shrines and grottos belonging to it, which are underground—is a stable for horses, with an entrance from the street at the higher side. Mr. Shiek, the superintendent of works connected with the English Bishopric, has represented this in his large wooden

model, which he favoured me by showing, when at Jerusalem last year; and which was afterwards forwarded to Constantinople, by desire of the Sultan, for his inspection. It was said that Mr. Shiek received 10,000 piasters for its construction.

Zahleh, though locally called a village, is yet a considerable town, and often designated the Capital of the Lebanon. It is built upon both sides of a ravine, very similar, as to slopes, to the Valley of Jehoshaphat; the houses on each side extend from the summit to the base of the declivity, and meet at the bottom as nearly as an intervening rivulet will permit.

I may mention that I visited Zahleh shortly after the massacre of the Christians, and a more deplorable sight, with ruins and wreck of burnings, I never beheld, except at Damascus, after the same cruel calamity. We are called upon by every claim on our humanity to aid Syria, and not abandon that beautiful country, which we were taught to praise in our earliest lessons, to be almost a desolation, as it is.

Many of the streets in Constantinople, especially those leading from the Bosphorus towards the Tower of Galeta, and that in which the American Consul-General resides, are as steep as the sides of Ophel, and in parts ascended by steps.

The village of Silwân, or Siloam, which is exactly opposite Jerusalem, the place in question, is situate on the face of a precipice, in places almost quite perpendicular ; but this would be scarcely a fair example to adduce, inasmuch as many of the dwellings there are sunk into the rock, and appear to have been originally sepulchres, enlarged by excavation and faced with masonry.

The following text, I consider, bears me out in the supposition that the ancient city extended to the base of the hill : “As the mountains are round about Jerusalem, so the Lord is round about his people from henceforth even for ever.” (Psalm cxxv. 2). For if the city be supposed to have extended down the sides of the valleys, then the opposite hills—viz., the Mount of Evil Council, the Mount of Offence, the Mount of Olives, Mount Scopus, &c.—would literally be “round about” her, and could be properly called mountains, in respect to the much lower ground upon which so great a portion of the city stood ; but if all the city had been upon the summit of a hill of nearly equal height to those which encompassed it, the expression could not be well applied, and would not even strike the imagination as expressive or just in poetry.

Thus we have seen that, if the city extended down the sloping-sides of the hill in the time of its *greatest* extension, the mountains above-named would, in just phraseology, be *round about* it; but in the time of David, when these words were spoken, the city had narrower limits.

We know from Josephus that Mounts Akra, Bezetha, and Moriah, were higher than they now are; and that the Tyropœon Valley, and that between Zion and Akra, were far deeper than at present; and we also know from the same historian, that the city, such as it then was, extended downward to the bottoms of these secondary valleys. Therefore, it appears to me that the mountains which David alluded to, as being round about Jerusalem, were Akra, Bezetha, Moriah, the Mount of Offence, the Mount of Evil Council, and that which bounds the Valley of Hinnom on the west, which is a continuation of the latter. It is to be remarked, however, that, so far as the last mount is concerned, it would not have much overtopped any propinquent portion of the city; as, on account of the very precipitous nature of the side of the valley opposite, it probably was not built upon; but much of the city having been clearly overtopped by hills on three sides, and having an adjacent hill of slightly

greater altitude on the remaining side ; the expression which David has used, was a refined poetical description, and, at the same time, graphically true.

The next step is to determine, within probability, the amount of the settled population of ancient Jerusalem. This I propose doing by instituting a comparison between it and the most crowded districts in London.

The maximum density of the population in the most crowded part of London (than which no city in the world, much less an Eastern city, could be more densely peopled without danger of engendering a pestilence) is estimated, by the Census of 1861, at $392\frac{1}{3}$ persons upon one acre ; and, according to the Census taken in 1851, the same most crowded district, that of St. Andrew, Eastern Holborn, contained $423\frac{1}{3}$ persons to each acre ; allowing only $11\frac{1}{2}$ square yards to each individual. Now, if $423\frac{1}{3}$ be multiplied by $479\frac{1}{4}$, the number of acres, as above estimated, in ancient Jerusalem, omitting, as in all similar cases throughout the book, a few additional square yards, the result is 202,882 as the total population : a most dense population, allowing, as in the most crowded parts of London, at a time when it was even more densely peopled than at present, only about $11\frac{1}{2}$ square

yards for each individual,* over the entire surface of the $479\frac{1}{4}$ acres, including the spaces occupied by walls of buildings, pools of water, the Temple area, palaces,

* Though the most crowded districts in London afforded, in 1851, only about $11\frac{1}{2}$ square yards to each individual, the average in the principal parts of the metropolis, as taken from the last return of the Registrar-General, that for 1861, varies from $12\frac{1}{3}$ in the said St. Andrew, Eastern Holborn—one of the poorest districts—to $40\frac{1}{4}$ in the City proper, the most mercantile district; $46\frac{1}{4}$ and 51 respectively in Belgravia and May Fair, the most aristocratic districts; and $59\frac{1}{2}$ in Westminster, the Parliamentary and Government offices district. The following tabulated particulars of a few of the well-known districts, which I have deduced from the Registrar-General's returns, will give a general idea of the whole:—

STATISTICS OF POPULATION IN VARIOUS DISTRICTS IN LONDON,
INCLUDING ALSO GREENWICH.

Name of District or Sub-District.	Area in acres.	Population	Number of persons per acre.	Number of sq. yards to each person.	Census, when taken	Observations.
St. Andrew, Eastern Holborn	33	12,947	$392\frac{1}{3}$	$12\frac{1}{3}$	1861	} Sub-district.
Ditto	33	13,971	$423\frac{1}{3}$	$11\frac{1}{2}$	1851	
Holborn	196	44,862	$228\frac{3}{4}$	$21\frac{1}{4}$	1861	
St. Giles	245	54,076	$220\frac{2}{3}$	22	1861	} Sub-district.
London City, N.W....	72	9,020	$125\frac{1}{3}$	$38\frac{2}{3}$	1861	
Ditto	72	11,847	$164\frac{1}{2}$	$29\frac{1}{2}$	1851	
London City, Proper..	379	45,555	$120\frac{1}{4}$	$40\frac{1}{4}$	1861	Exclusive of water.
Belgravia	525	55,113	$104\frac{3}{4}$	$46\frac{1}{4}$	1861	Exclusive of water.
May Fair	136	12,885	$94\frac{3}{4}$	51	1861	Exclusive of water.
Westminster	839	68,213	$81\frac{1}{4}$	$59\frac{1}{2}$	1861	
Greenwich	4,590	127,670	$27\frac{3}{4}$	$174\frac{1}{2}$	1861	

In compiling this table I have avoided the introduction of decimals; and employed instead the nearest whole number, or vulgar fraction not less than $\frac{1}{4}$, whether above or below.

According to Mr. Fergusson, the City proper, as estimated in

streets, &c., &c. I feel confident, therefore, that I am safe in assuming that the settled inhabitants, those which might be termed the true population of the city, could not have exceeded this number, however far they might have fallen short of it.

Josephus states that, at the time of the siege by Titus, there were upwards of 1,200,000 people shut up within the walls; but then he mentions that the greater proportion of them quickly perished from pestilence and famine, besides those who were taken prisoners and fell in battle; thus probably in a short time reducing the number to that above fixed upon, with much reason, as the utmost possible number of resident inhabitants.

It is evident from his words—"vast concourse" "collected from *without* the city;" "on this occasion the whole nation had been shut up as in a prison," and similar passages—that at the feast of the Passover, the whole nation—that is, all able-bodied persons—came up *to* Jerusalem; the probability is that the majority of them encamped *without* the city; but that on this special occasion, being surprised by the Roman army,

1840, afforded 30 square yards to each inhabitant; and an average, extending over the entire metropolis, was ascertained at 118 square yards for each.

they rushed for protection within the walls, and were thus "*crowded*" together "as in a prison."

It is evident, from what I have already shown, and dividing 2,319,850, the total number of square yards within the ancient walls, by 1,200,000, the number of persons said by Josephus to have been shut up therein, that they could have had little more than bare standing room, less than two square yards for each individual, including the space occupied by walls, pools, &c. ; consequently they must have rapidly died in multitudes ; and Josephus, in effect, states that so they did—"their confined situation caused *at first* a pestilential *mortality*."

In the reign of Nero, a census was taken by Cestius Gallus, President of Syria, of those who annually attended the Passover, for the information of the Emperor, which gave a result of 2,700,000 persons, in addition to which, the beasts they brought with them for sacrifice were numbered at 256,500 ; but it is not pretended that these millions of people and hundreds of thousands of cattle entered within the city, which was then encircled by the two first walls only, and probably occupied little more than one-half the space which was included after the addition of the third wall ; a great proportion of them must have lain

in encampments outside. In fact, one-fourth part of them could not have found room within ; so that in all reason, and for the sake of common sense, controversy on that topic should cease.

If the statement of Cestius was not an exaggeration, there was a great falling off in the number of those who attended the Passover in the time of Josephus, for he sets down the entire number shut in by Titus at about 1,200,000, or less than one-half that which, according to the former, attended the feast in the days of Nero ; and if, as is probable, in the time of which Josephus writes, a portion of the multitude were encamped outside, and that, when they rushed into the city for protection, they brought with them their cattle—which they would not willingly have relinquished to the approaching Roman army—they must *of necessity* have had but bare standing-room, even within the enlarged walls ; for, as I have already proved, even exclusive of the cattle, the space would have afforded less than two square yards for each individual, stretching the walls to the utmost extent that the limit of our measurement, 33 stadia, will allow. Therefore, the crowded state of the entire city must have been as great as that of the leading thoroughfares in London, during the recent

illumination for the Prince of Wales's marriage ; where men, women, children, and horses, were pressed together in actual contact ; and, on that occasion, the number of horses under the vehicles might have borne about the same proportion to the people, as the cattle brought for sacrifice to Jerusalem bore to the multitude there. And likewise, as much of the space within the walls of Jerusalem was occupied by buildings, &c., which prevented all the ground being available for standing-room ; so also, in the thoroughfares of London, on this occasion, was much of the space—perhaps, the same proportion—occupied by wheeled carriages : therefore, on the whole, I presume the analogy between the two cases is not very wide, and that those who witnessed the latter event may form a very good idea of what the crowded state of Jerusalem, at the time in question, must have been.

Speaking of those shut in by Titus, Josephus says, “Of these the greater proportion were of Jewish blood, though not natives of the place. Having assembled from the whole country for the feast of unleavened bread, they were suddenly hemmed in by the war, so that their confined situation caused at first a pestilential mortality, and afterwards famine also, still more rapid in its effects. . . . This vast concourse is [was] collected

from without the city, but on this occasion the whole nation had been shut up, as in a prison, by fate, and the war encircled the city when it was crowded with men ; accordingly those who perished exceeded in number all that had been swept away by any visitation, human or divine."

I quote these passages at full length to show that there is nothing in Josephus contrary to the assumption I have made as to the probable number of the regular population, and to guide us in computing the quantity of water which must have been supplied to the ancient city ; which quantity having been lost for centuries should now be sought for and restored. What has been accomplished can be done again. We should, in the first place, ascertain what quantity of water it is reasonable we might expect to find. The answer is, at *least* as much as the city formerly possessed ; making allowance for such diminution as may have arisen from the cutting down of timber, and denuding of the country.

Having got a tolerably accurate idea of the number of inhabitants in the former city, and knowing that they possessed a sufficiency of water during the siege by Pompey—for Strabo states, as adding to his renown, that Pompey captured it, notwithstanding its

strong defences, and its having sufficient water, “*εντος μεν ευυδρον, εκτος δε παντελως διψηρον*” (within, truly well watered; but without, altogether dry)—and also that they had sufficient water during the siege by Titus, which lasted upwards of four months and a-half, from the 13th of April to the 2nd of September, A.D. 70; our next inquiries must be, What is the minimum quantity which would have sufficed for such a population during that length of time? and, What quantity per day would it have amounted to?

What proportion of it might have been stored up in cisterns within the city? what derived from aqueducts or springs? and were the springs inside or without the walls? These three latter questions do not concern our present purpose, and therefore we need not inquire into them.

SECTION 2.

MINIMUM QUANTITY OF WATER WHICH COULD HAVE SUFFICED FOR SUCH A POPULATION.

Fifteen gallons of water per day for each individual is the least that, in a European town, exclusive of manufactures, is deemed sufficient for the comforts and necessities of life. In ancient Rome, according to the computation of Professor Leslie, the supply

of water amounted to 312 gallons a day for each individual ; and in the city of New York, at the present time, the amount is nearly the same. Mr. Neville says : “ The number of gallons of water required for the supply of each person, including all collateral uses, has been differently estimated, and varies in almost every town, and even in the same city—London, for instance, when supplied by different companies and under different systems. 44 gallons per head, per diem, were supplied by the several companies of London in 1853, while evidence has been given to show that the actual average consumption for all purposes did not exceed 10 gallons per head, per diem ; the remainder having been wasted under an imperfect system of distribution. It is asserted that when the supply is 25 gallons per head, per diem, that 5 gallons of it are used for purposes requiring filtration, 10 gallons for purposes not requiring filtration, and 10 gallons wasted, or two-fifths of the supply. As there must be a considerable loss under even the best system of supply, we may assume, with the Board of Health, that a *minimum supply* of 75 gallons per house, per diem, or 15 gallons per person, per diem, is necessary.

“The following is an abstract of the average num-

ber of gallons of water furnished per diem, by different water companies in London, during the year 1853, to each house, including manufactories and public establishments as houses :—

	Gallons.	
	Per House.	Per Person.
New River Company	193	38·3·5
East London Water Works . .	187	37·4·5
West Middlesex Water Works .	204	40·5·5
Grand Junction Water Works. .	{ 319 336	{ 63·4·5 67·1·5
Southwark and Vauxhall Companies' Houses }	175	35
Ditto average Houses, Manufac- tories, Public Establishments }	209	41·4·5
Chelsea Water Works	227	45·2·5
Hampstead Water Works . . .	111	22·1·5
Kent Water Works	270	55
	2,233	446·3·5
Mean values	223·3·10	44·3·5

“These quantities have been calculated from the parliamentary returns made in 1854 ; and if there be any truth in the calculations and returns of the quantities actually consumed per person—said to be 10 gallons—we get the proportion, as 10 is to 34 so is the quantity consumed to the quantity wasted. But, even assuming the quantity consumed to be 20 gallons

per head, what an immense loss is here exhibited from want of a suitable system of distribution.

“For large towns it is safe to provide for many purposes, besides mere personal or house wants; and it is safer, where it can be done without much cost, to provide for a supply of 40 gallons to each inhabitant, even if this quantity shall not be used or raised. For high pressure, the supply required will generally vary from 15 to 42 gallons, or from 3 to 7 cubic feet to each inhabitant, or an average of about 30 gallons, including the supply of stables, offices, manufactories, and breweries.”

Omitting comforts, and dealing only with necessities, we cannot imagine that less than five gallons a day for each individual could suffice under any circumstances, even with all the economy which a state of siege would necessitate, much less in an overcrowded city, under an Eastern sun.

Assuming the population, as above (Sec. 1 of this Chap.), at 202,882, five gallons a-day for each individual would be 1,014,410 gallons per day, which for 143 days, the time occupied by the siege (Sec. 1 of this Chap.), would be $1,014,410 \times 143 = 145,060,630$ gallons.

SECTION 3.

EXTENT AND POPULATION OF THE PRESENT CITY.

The extent of the present city within the walls is 1,032,148 square yards, equal to $213\frac{1}{4}$ acres, and 18 square yards (Sec. 1 of this Chap.); and taking the population at 20,330, the late estimate, as taken from Dr. Pierotti, it allows nearly $50\frac{3}{4}$ square yards to each individual.

Dr. Pierotti has given the number of persons in each of the different sects and denominations which constitute the population, as under :—

PRESENT POPULATION OF JERUSALEM.

Name of Sect or Denomination.	Number of individuals.	Name of Sect or Denomination.	Number of individuals.
Latins	1,265	Disciples	10
Greek Orthodox	2,760	Sabbatarians	3
Greek Catholics	22	Arabs—Moslem	6,916
Armenian Catholics . . .	16	Turks—Moslem	640
Armenians	510	Jews, Saphardin	5,200
Copts	130	Ditto, Askenasim. . . .	2,470
Abyssinians	75	Ditto, Karaïtes	36
Ch. of England Protests.	205		
Lutherans	60	Total	20,330
Armenites	12		

In addition to the regular population of Jerusalem, a number of pilgrims arrive about Easter every year, but their sojourn being of short duration, I shall take no special account of them in the estimate. Dr. Barclay supposes their number to average about 8,000; but Fuad Pasha, now Grand Vizier, and previously, during the disturbances, Imperial Commissioner in Syria, estimates the number of pilgrims annually visiting Jerusalem at 60,000, from the four parts of Gaza, Jaffa, Caipha, and Beirût alone. There is a wonderful discrepancy between these estimates, which only shows how very difficult it is to obtain reliable statistical information in that country.

It is interesting to compare with this the relative populations and relative areas of other cities, selected in various countries. I therefore, in the Appendix, No. 1, have given some statistics on that head, which may be useful.

SECTION 4.

QUANTITY OF WATER SUPPLIED TO THE PRESENT CITY.

As shown in Chap. IV., Sec. 5, the average annual depth of rain-fall in Jerusalem is 65 inches; which upon one acre would yield 235,950 cubic feet. This

multiplied by $213\frac{1}{4}$, the number of acres, omitting a few square yards, will give 50,316,337 cubic feet of rain-water, which falls within the walls during one year; and allowing that, without any waste or loss by evaporation, the whole of this could be caught in cisterns, it would yield throughout the year a daily supply of 137,853 cubic feet, equal to 859,113 gallons per day, or more than $42\frac{1}{4}$ gallons for each individual; assuming, as before, the population at 20,330.

Facts, therefore—and facts are stubborn things, one of which is worth a thousand arguments—prove that there is no grounds whatsoever for the assertion—which has been so often made that it has become fashionable, and copied without consideration from one book into another—that in consequence of a curse over the land, there is of late a scarcity of water from the heaven. On which subject I shall give some details in Chap. IV., Sec. 5. The average rain-fall in England—which is universally admitted not to be by any means deficient in water—is, as shown by Mr. Beardmore's hydraulic tables, for the whole country less than one-half, and in some districts little more than one-third of that which is at Jerusalem. For example, a mean of five years' rain-fall at Greenwich Observatory, ending with 1859, was

21 $\frac{1}{2}$ inches ; and the mean of forty years there, ending with the same year, was 24 $\frac{9}{10}$ inches ;* whereas, at Jerusalem, a mean of twelve years' rain-fall, nine of which, ending likewise with 1859, and the other three with 1848, is shown, as before stated, to have been 65 inches in depth. Therefore, we should not accuse Providence with sending a deficiency, but man for improvidence in not economising His gracious abundance.

Under present circumstances, arrangements are not made for collecting the total quantity which the rain-fall within the city is capable of yielding ; it is, therefore, necessary to inquire, what is the actual amount collected of the total quantity, and used by the population ?

The Haram enclosure, named by the Moslems el-Haram esh-Sherîf, the Noble Sanctuary, contains 168,236 square yards, as taken from the most modern maps, equal to something more than 34 $\frac{3}{4}$ acres ; and deducting from the remaining space within the city walls, equal to 863,912 square yards, all waste ground and unoccupied spaces, which amount to about 181,290

* The general mean rain-fall for all England, according to Mr. Neville, is supposed to be 31 $\frac{1}{4}$ inches ; and for the locality of London 25 inches.

square yards, there remains an extent of 682,622 square yards occupied by buildings, streets, yards, tanks, &c. There are about 17,979 lineal yards of streets, with an average breadth of about 9 feet;* this gives 53,937 square yards under streets, to be deducted from the 682,622 square yards occupied by buildings, streets, &c. ; which gives 628,685 square yards as the space, exclusive of the Haram area, from which the rain-fall is actually, though but partially, collected by the inhabitants.

Add to this the Haram area, equal to 168,236 square yards (for the Moslem portion of the inhabitants are allowed to draw water from the cisterns within it), and we get 796,921 square yards, equal to $164\frac{3}{4}$ acres nearly, as the total space within the walls, from which any rain-water could, under the existing condition of things, be received for the use of the city.

Sixty-five inches in depth annually upon this extent of surface would produce 38,872,762 cubic feet of water, or 242,259,719 gallons ; equal to 106,501 cubic feet, or 663,726 gallons per day, being more than $32\frac{1}{2}$ gallons per day for each individual.

* Dr. Barclay says many of the streets average 12 feet in breadth ; but a great number not above half that width.

We have already seen from Sec. 2 of this Chap. that 1,014,410 gallons per day, for 143 consecutive days, was the very least with which the ancient city could have been supplied ; or, as it is most reasonable to suppose, that the Romans cut off all aqueduct supplies from without the walls, and as it is most improbable that there are any self-supplying wells within the walls (as I shall show in Chap. IV., Sec. 1, on the theory of springs, and in Chap. V., Sec. 1), the conclusion follows, that the ancient city possessed also reservoir accommodation for that quantity, multiplied by the number of days the siege lasted—that is, receptacles capable, in the aggregate, of containing 145,060,630 gallons at the least—and that when the siege commenced the citizens had in store that minimum of water.

There are only three other sources within the city, or in the immediate vicinity, from which it at present derives any water. These I shall describe separately, and estimate as nearly as practicable (in the absence of recorded observations extending through different seasons) the quantity of water yielded daily by each throughout the year ; and particularly speak of the minimum summer quantity, it being *that* which in reality affects the welfare of the city, in its present want of tank and reser-

voir accommodation to store up the superabundant waters of winter, which now of necessity run to waste.*

First—A small duct conveys the water underground from Birket Mamilla, the Upper Pool of Gihon, into Amygdalon, the Pool of Hezekiah. (See Chap. II., Secs. 4 and 9.) As there are no proper means adopted for collecting the water from the surrounding country into this Upper Pool of Gihon, in which there exists no spring during summer, and but a variable one in winter, I do not believe that, on an average of the entire year, more than 3,000 cubic feet, equal to 18,696 gallons, per day, flows into, and after evaporation remains in, the Pool of Hezekiah; and I am confident that towards the end of summer the flow must very often totally cease. I shall, however, give it the benefit of any doubt which may exist in peoples' minds, and assume that at the dry season it still may yield 700 cubic feet per day, equal to 4,362 gallons.

Second—Ain Hammam esh-Shefa, the Fountain of the Bath of Healing, situate in the Mill Valley, and which I shall describe more fully in Chap. II.,

* This lamentable waste of the winter rain, and the breaking down of the aqueduct from Solomon's Pools, necessitates, in summer time, the carriage of water from great distances.

Sec. 5, possesses, in my opinion, a deep-seated tunnelled aqueduct, leading into it from Ain es-Suâni, in the bend of the Valley of Jehoshaphat, about 530 yards from the N.E. angle of the city wall, and which aqueduct, if it exist, judging from the situation of Ain es-Suâni, may also probably supply 700 cubic feet, equal to 4,362 gallons per day, in the driest season ; but it must be remembered that the existence of a concealed permanent spring at Ain es-Suâni, and likewise of an aqueduct, are as yet not proved ; but in Chap. III., Sec. 1, I shall show reason for supposing their existence probable.

The truth respecting them might be easily ascertained, if the Pasha would permit of a slight exploration, by digging a trench between Ain es-Suâni and the city, in the lowest ground, where the aqueduct, if it exist, must necessarily be near the surface ; and if that were found, it would lead to the discovery of the fountain head. In this case likewise, allowing the benefit of a doubt, we may assume in our calculations that the Fountain of the Bath may receive 4,362 gallons per day as a minimum from an external source.

Being, of course, unable to calculate upon any particular depth for this supposed well, we are provided

with no sufficient data to form even a rough estimate of the average daily quantity it might yield throughout the year; but I shall show further on (Chap. V., Sec. 1) what we might confidently expect that a well, which I would propose sinking at that place to a proper depth, might produce, calculating upon the extent of the tributary district, the nature of the ground, and the stratification of the rocks.

Third—The Pool of Siloam, which probably yields a minimum of 10 gallons per minute, equal to 14,400 gallons per day; all received from the Fountain of the Virgin. (See Chap. II., Secs. 6 and 7, and Chap. V., Sec. 1.)

En Rogel, called also the Well of Job, periodically overflows in winter, but in hot weather it frequently becomes almost dry; therefore, as a summer source, in the drought of the season, it is scarce worthy of consideration. (See Chap. II., Sec. 8.)

During summer the poor people carry water to Jerusalem, in goatskins, upon their own backs, or on asses, from En Rogel; and when it ceases to supply all that is required, a number of them must then go to Ain Yâlo, Ain Horth, Ain Lifta, and other springs, miles distant, to make up the deficiency. The quantity conveyed from En Rogel may be estimated in the

dry season at about 12,500 gallons per day, and that from Ain Yâlo and other distant sources at about an equal quantity; and these together constitute the third and last source from which, exclusive of the rain falling within the walls, the modern city is supplied with water.

The following extracts from Dr. Barclay's Note Book, given in his valuable work, "The City of the Great King," in which will be found a great quantity of original information, supply the means of arriving at this estimate :—

"Oct. 26, 1852.—Depth of water in Bir Yûab (before the fall of rain) $42\frac{1}{2}$ feet. Hundreds of donkey-loads of water daily carried to the city—perhaps a thousand.

"Sept. 12, 1853.—Two thousand donkey-loads daily carried to the city—4,000 skins, or 25,000 gallons.

"Oct. 7.—Only $6\frac{1}{2}$ feet deep of water.

"Nov. 18.—Twenty-one feet deep. This increase of depth is not due to the few showers that have fallen; but because much less is now required for city consumption—since a little rain has found its way into the tanks.

"March 2, 1854.—The well has been overflowing

vigorously for some days ; also the fount ed-Durrage—the former venting at least two or three hundred gallons per minute, the latter perhaps forty or fifty. Well continued flowing till the last of March, twenty-four or twenty-five days in all.

“April 6.—Well has been again overflowing two or three days—though not venting more than twenty gallons per minute—and this stream is absorbed into the earth before it reaches Ain ed-Durrage, four hundred yards below.”

The conclusion which I draw is, that 4,000 skins, or 25,000 gallons, is the quantity of water which the poor in Jerusalem lack for the absolute necessities of life, above that which their deficient cisterns supply during the drought of summer. So long as En Rogel can yield that quantity, they draw exclusively from it ; but when the water therein becomes scanty, and produces daily about half the requisite amount, they are then forced to draw from distant wells.

At first sight it may appear inexplicable that, on the 26th of October, 1852, in the very driest part of the year, immediately “before the fall of rain,” only 1,000 donkey-loads, or 2,000 skins should be conveyed to the city ; whilst in September, 1853, earlier in the

dry season, and consequently before water had become so scarce, as it must naturally have been a month later (it being on the whole a drier *year* than the preceding, as may be seen from the extract from Beardmore's tables, which I have given in Chap. IV., Sec. 5), double that quantity, or 4,000 skins, were conveyed to the city; and, yet, that in the former case there should appear to have been abundance of water in the well—a depth of $42\frac{1}{2}$ feet.

I can only endeavour to account for this, by supposing that Dr. Barclay took his measurement of the depth at an early part of the day, whilst the well contained the accumulated water which flowed into it during the period of rest the preceding night; whereas towards evening it is probable that the withdrawing of the 2,000 skinsful had quite exhausted it, or nearly so.

The section of this well, given me by Mr. Finn, the British Consul, shown further on, in Chap. II., Sec. 8, was taken during the corresponding month, in the year 1847, and shows it almost entirely empty. Yet, in Beardmore's tables (see Chap. IV., Sec. 5), I find that it was a wetter year than either of the other two; and, therefore, I presume that Mr. Finn's section was taken late in the afternoon, when the

operation of drawing water during the day had abated the supply.

In a wood-cut copied from a photograph by the Rev. A. A. Isaacs, and published in his "Pictorial Tour in the Holy Land," may be seen the rude machinery by which the water is raised ; consisting of a rope and leather bucket, suspended from a transverse beam ; also the dilapidated state of the building over the well may be observed. By reason of their truthfulness, the drawings in that book, having been taken from photographs, are instructive.

We can now determine, by adding the probable quantities from the four stated sources together, what may be the total daily supply, at the most sultry season of the year, when misery, disease, and inconvenience arising from a scarcity of water are most severely felt.

We have seen, in the foregoing part of this section, that, by proper arrangements, collecting the water quickly, before any appreciable loss could occur by evaporation, and tanks of sufficient capacity, a quantity which would yield 663,726 gallons per day might be obtained from the roofs, paved yards, &c., of the city, in the present state of its buildings ; but I have no hesitation in stating that, from the deficiency

of storage room and tank accommodation, the leaky condition of many of the cisterns, and want of care in the majority of the poorer class of houses, to conduct *all* the water from the roofs, &c., into them, one-twentieth of that quantity is the utmost actually preserved.

We shall, therefore, take one-twentieth of the above—equal to 33,186 gallons—as the quantity of rain-fall actually rendered available for each day. Add to it the supplemental quantities from the Pool of Hezekiah, the Fountain of the Bath of Healing, En Rogel, Ain Yâlo, Ain Horth, and Ain Lifta, with the other distant wells, and the result is 66,910 gallons per day as a total quantity, or little more than $3\frac{1}{4}$ gallons per day for each individual.

PRESENT SUMMER QUANTITY OF WATER SUPPLIED TO
JERUSALEM.

Source whence obtained.	Gallons per day.
Quantity rendered available from } Roofs, Yards, &c. }	33,186
Do. from Pool of Hezekiah	4,362
Do. from Fountain of the Bath of } Healing }	4,362
Do. conveyed from En Rogel	12,500
Ain Lifta and other distant Wells . .	12,500
Total	66,910

SECTION 5.

QUANTITY OF WATER PER HOUSE AND INHABITANT,
COMPARED WITH THAT IN LONDON.

Thus, by comparing the foregoing with the table in Sec. II. of this Chap., it appears this city receives per individual scarcely more than one-thirteenth of the quantity supplied to our metropolis by pipe-water alone, without at all taking into account the number of private wells, or the quantity of rain-water collected from roofs of houses, which in itself yields more than $1\frac{3}{4}$ gallons per day for each person, on an average, for the whole of London, taking sixty square feet as the average roof surface for each individual, and $21\frac{1}{2}$ inches in depth as the annual rain-fall. (See Sec. 4 of this Chap.) Moreover, when we consider that baths, and other luxuries for the rich, as in all Eastern cities, deprive the poorer classes of even their due proportion of this scanty quantity, we may well imagine that ablutions can be seldom indulged in by the majority of the population, and habitual cleanliness never.

These are the words of Professor Porter with respect to the poor Jews in Jerusalem: "The disease and suffering occasioned by bad food, crowded dwell-

ings, and *scarcity of water*, are beyond description. . . . There is more abject poverty and squalid misery existing among them than among any other class in the whole land. . . . The Jewish quarter has no structure of note. It embraces the eastern declivity of Zion, and the deep valley below—the very spot where the proud palaces of their ancient monarchs once stood. Alas! how are the mighty fallen! How sad is the contrast between former glory and present misery! Now clusters of tottering houses, and crooked, filthy lanes, crowd the site of Solomon's gilded halls and Herod's marble courts; while squalid poverty crawls along where gold and diamonds glittered of yore!"

SECTION 6.

LEAST QUANTITY OF WATER SUFFICIENT FOR AN EASTERN CITY.

Five gallons per day for each individual, in an Eastern town, should undoubtedly be considered the very least sufficient in any degree to avert discomfort, disease, and uncleanness.

I may here mention, incidentally, a most important use for which water is totally wanted at Jerusalem—to wash away the blood and offal of the animals killed

for food. The slaughter-ground, which, till recently, was within the walls, spreading disease around, is now in the valley of the Kidron, opposite the city; and for want of a running stream, the blood and entrails of the cattle are left to putrify upon the heated soil, exposed to the full power of the sun, in a hollow sheltered from the winds. The only road through the valley, which, like all other roads in Syria, is a mere path or track-way, runs directly through this dreadful place. The stench is insupportable; and it is something almost frightful to see the foul birds, which feed upon carrion, floating over head, allured from afar by the smell of this reeking, horrible spot.

CHAPTER II.

I shall now enumerate all sources and receptacles for water in the city and its immediate vicinity, whether at present in a state of efficiency, or otherwise.

SECTION 1.

THE BROOK KIDRON.

This appellation is calculated to mislead, and make people unacquainted with the locality suppose that a brook, properly so called, or perpetual running stream, exists there, whereas the contrary is the case. In the Ravine of the Kidron, part of which, from the Fountain of the Virgin to Ain es-Suâni, about 1,800 yards, is also named the Valley of Jehoshaphat, there exists no stream at any time, except after a heavy winter shower, when a temporary rill is generated, which, in the upper portion, ceases almost simultaneously with the rain that gave it birth ; but below En Rogel, due to the overflowing of the well,

mentioned in Chap. I., Sec. 4, the stream is more considerable, and occasionally lasts for four or five weeks without intermission. In the Arabic language the name is "Wady-Yehôshâfât," or *wady* of Jehoshaphat; *wady*, for which there is no corresponding word in our language, signifies a narrow valley, or glen, in a mountainous district, through which a torrent rushes after heavy rain, but which at other times is dry.

The Ravine of the Kidron commences about 2,000 yards N.W. of the city, and running in a southeasterly direction till within 1,100 yards, it bends and continues in an easterly course for about 1,200 yards, and then, turning southward, passes along the eastern wall of the Haram, and continuing 900 yards beyond it, is joined by the Valley of Hinnom, which environs the city on the W. and S.

The rain which falls within the walls, as already mentioned, is, according to the invariable habit in Eastern towns, partially collected in cisterns and artificial pools, by means of small channels and pipes; the sediment subsiding, the water becomes clear, and useable for drinking and culinary purposes. The want of stanchness in the walls of the cisterns, which frequently occurs, causes contamination of the water, because of the usual vicinity of cesspools, and ac-

counts for much disease; and the want of efficient public sewers prevents the cleaning out of the cess-pools.

Jerusalem, many times, has been sacked and destroyed, and frequently has a new city been erected upon the ruins of the old. The present city stands upon the *débris* of temples, palaces, houses, tanks, and cesspools, with almost all the accumulated filth of ages, to a depth varying from twenty feet on the higher ground to sixty feet in the depressions (see Chap. VI., Sec. 2); the Haram enclosure, wherein formerly stood the Jewish Temple, being the only portion wherein the original surface of the ground is now discernible.

SECTION 2.

GREAT RESERVOIR BENEATH THE HARAM—GREAT SUBTERRANEAN CISTERN OF THE JEWISH TEMPLE—ROYAL POOL.

Beneath the Haram there exists a cistern of vast dimensions, till recently unknown to modern Europeans, excavated in the solid rock, the sides coated with cement, and the roof supported by numerous columns built of rough stone, or hewn out of the original material. It was known to the ancients, for

Tacitus (Hist. v. 12) speaks of it thus: "Fons perennis aquæ cavati sub terra montes: et piscinæ cisternæque servandis imbribus" (a fountain of perennial water; mountains hollowed out under the earth; also fish-pools and cisterns; rain-water being preserved). In the Chronicles of the Crusaders, this immense cavern reservoir is called the Royal Pool. It was formerly supplied with running water, for the ablutions of the Jewish priests and the service of the Temple, by an aqueduct from the Pools of Solomon, about seven miles distant, but it serves now only as a receptacle for the rain-water from the roofs of the Mosques of Omar and El Aksa, and the surface of the enclosed court, called the Haram, wherein they stand.

I obtained permission from the Pasha, together with Mr. Alexander Finn, the British Consul's son, to descend into this huge reservoir, which has well been described as "a beautiful subterranean lake," and in Ecclesiasticus l. 3, is termed "the cistern to receive water, being in compass as the sea."

The same chapter of Ecclesiasticus further states, that when Simon the Just, son of Onias, was high priest, about three hundred years before the Christian era, this great cistern "was covered, or lined, with

plates of brass." Aristeeas, who, shortly after the death of Simon the Just, was sent by Ptolemy Philadelphus on a special mission to Eliezur, the reigning high priest, to obtain an authentic version of the Hebrew Scriptures into the Greek language (*Ant. XII., II. 1—15*), in describing the waters of the Jewish Temple, thus speaks: "A powerful natural spring gushes out copiously and unceasingly from within, and is received into subterranean reservoirs, the extent of which is surprising and beyond description, to the circumference of five stadia about the Temple. They are connected by numberless pipes, through which the waters flow from one to another. There are above frequent hidden apertures to these depths, known only to those employed at the sacrifices, through which the water, gushing out with force, washes off all the blood of the numerous victims. The reservoirs have their floors and sides cased with lead, and are covered over with a quantity of earth." (See Williams' "Holy City," Vol. II., p. 463.)

Aristeeas adds: "And I will tell you how I came to know of these underground receptacles; they brought me out more than four furlongs [same as four stadia] space out of the city, and one bade me stoop down and listen what noise the meeting of

the waters made." (See Dr. Lightfoot, Vol. I., p. 2010.)

There can be no doubt that in the foregoing description he alludes, among other hydraulic works, to this great cistern; but it must be observed that whilst he speaks of the subterranean reservoirs as being cased with lead, the Son of Sirach, the writer of Ecclesiasticus, states that the Great Cistern was lined with brass. This is an unimportant discrepancy; the material used may in fact have been in constitution a compound metal like brass, but in appearance resembling lead, a pure metal. Many varieties of such compounds are used by us in structure; and are known to have been employed by the ancients.

The Bourdeaux Pilgrim, who visited Jerusalem A.D. 333, includes this cistern in his account. "There are three great receptacles of subterranean water, and fish pools, built with great labour; and in the house itself where the Temple was which Solomon built." (Itin. Hierosol, p. 152.)

Philo mentions "the fountain and the pipes of the High Priest's fountain spouting water," from which words I gather that the High Priest had a *jet d'eau* within the Temple enclosure, such as that recommended, amongst others, in Chap. V., Sec. 5, to be

now erected in the same place—*i.e.*, within the Haram grounds.

Eusebius, who was a native of Palestine, and died there about the year 340, confirms the accounts of Aristeas, and the other writers cited. In one part of his works (Præp. Evang., Lib. IX., Capp. xxxv.—xxxvii.) he thus quotes Timochrates, “the Surveyor of Syria” : “The whole city flowed with water, so that even the gardens were irrigated of those overflowing waters out of the city. But round about for forty stadia to be without [water], but from these forty stadia water again to exist.”

I cannot think I am wrong in the inference I draw from this statement of Timochrates, which, to say the least of it, is badly worded, and obscure in its meaning; and I shall venture to put it forward, as it is in unison with the conclusion I have arrived at respecting the present state of the climate and the physical structure of Judea, as compared with their former condition; and corroborates the opinion, that they do not differ materially, if at all, from what they were at the earlier historic periods. He says that the gardens around the city were “irrigated,” as in Chap. V., Sec. 5, I have recommended they should now be, with the “flowing waters out of the city;” that in the vicinity there was

no water ; but that at a distance of forty stadia water did exist. This unquestionably shows that there was then no stream in the Kidron in dry weather, *as now* ; that there were then no copious springs in the vicinity, *as now* ; and consequently that the abundance of water with which “the whole city flowed” must have been derived from aqueducts, *as should be now*. That the aqueducts were covered, or tubular, we may also infer, or he could not with propriety say that round about the city there was no water ; that is, as I take it, no water *visible*. And I think it apparent, also, that he alludes to the Pools of Solomon, when he says that at a distance of forty stadia there was water ; for, as mentioned in Chap. V., Sec. 5, their actual distance in a straight line from the Temple wall is about six miles and seven furlongs, approximately fifty-five stadia ; which Timochrates, though a “surveyor,” perhaps not being very careful in his measurement, or having only estimated by sight, roughly set down as forty stadia ; as people of the present day often judge distances by sight, and are not very accurate.

Dr. Traill, in his notes to Josephus, in speaking of the occult connexion of causes, which no doubt had much influence in securing to Jerusalem so great a supply of water, says : “The Jewish public worship

was, if we might so term it, a ceremonial of ablution ; and Judaism, considered as a personal and domestic scheme of life, was a routine of endless washings. Now one would have thought, on grounds of ordinary calculation, that the founder of such an institute—of this public ritual, and of this individual ceremonial—the promulgator of this religion of ‘divers baptisms’—of this scheme of life for a nation, demanding that their persons and utensils should often be washed, and should daily be plunged in water—was looking forward from the scorched wilderness of Sinai to some region of many streams, and of gushing fountains, as the destined home of his people. One would have thought that Moses was intending to make, not Jerusalem, but Damascus, the metropolis of the Israelitish worship—Jerusalem, reared among limestone mountains, and scarcely blessed, within a circuit of many miles, with so many as two or three natural springs ; and yet this vast city—this central point as it is of drought—has, from age to age, known no thirst within its walls ! The series of writers from Strabo down to William of Tyre use almost the same phrase, at once in describing the aridity of the region, and in attesting the fact, that within the city there was always water enough and to spare !

“ Now it is obvious to remark that this abundance, so important to the health and comfort of a densely-crowded city, has been the consequence of this very peculiarity of the religious system of the people. This system, demanding so large a supply of water, has, from the earliest ages, secured to the population as ample a supply as is enjoyed by the inhabitants of cities that are the most favoured in this respect by their nearness to rivers, and by the copiousness of natural springs. In Jerusalem the collection and conservation of the rains of the winter months became, at the impulse of a religious necessity, the first law of the municipal economy of the State.”

I found in the reservoir about two feet of clear water. The opening through which we let ourselves down is like the mouth of a well several feet deep, at the bottom of which commences a broad ruined flight of steps, cut in the natural rock, leading down to the water's edge.

Dr. Barclay, who discovered this reservoir, about the year 1853, says: “ It is 736 feet in circuit, and 42 in depth.” He must mean from the surface of the ground overhead, and not the interior depth of the reservoir; for he elsewhere states that the bottom of the Fountain of the Bath of Healing is 33 feet lower

than this reservoir; and in another place, that the said Fountain is nearly 85 feet deep; and again, that its mouth is 10 feet above the level of the Haram ground. Taking 10 feet from 85, we get the depth of the well as 75 feet below the level of the Haram ground; and deducting 33 feet, which the bottom of the Fountain is lower than the reservoir, from 75, it gives 42 as the depth of the latter below the surface of the ground.

He also states that, "according to the best estimates he could make, its capacity falls but little short of two million gallons."

SECTION 3.

MINOR CISTERNS WITHIN THE HARAM.

Within the Haram enclosure are also other cisterns of smaller dimensions, the openings to which are to be seen at several points, and present the appearance of so many wells' mouths, numbering thirty-two in all, though some of them are nearly choked with rubbish. Of these there are three close together, opening into three large tanks between the Golden Gate and the Mosque of Omar; one near the Gate of the Chain, opening into a cistern 33 feet in depth, called the Well of the Leaf, from a strange legend that is

narrated respecting it by the Arab historian, Mejr ed-Din ; and another within the Mosque El Aksa, whose cistern is 47 feet below the surface.

There are two receptacles for water within the city—and perhaps only two—which cannot strictly be classed among the system of house tanks, inasmuch as they are not directly supplied by rain-water from roofs and yards. They have both been already referred to, but it is necessary here, in giving a complete catalogue, to enumerate and further describe them.

SECTION 4.

AMYGDALON—POOL OF HEZEKIAH.

The first is the Pool of Hezekiah, situate on the north of David Street, and about 140 yards from the Jaffa Gate (see Chap. I., Sec. 4, and Chap. II., Sec. 9). According to Dr. Robinson, it is 240 feet long by 144 wide. He does not mention its depth ; but, according to Dr. Barclay, it is 10 feet deep below the general surface of the ground thereabout ; containing therefore 345,600 cubic feet. It is chiefly supplied by a small underground channel from the Upper Pool of Gihon, 790 yards from it, outside the city, and 672 yards from the Jaffa Gate.

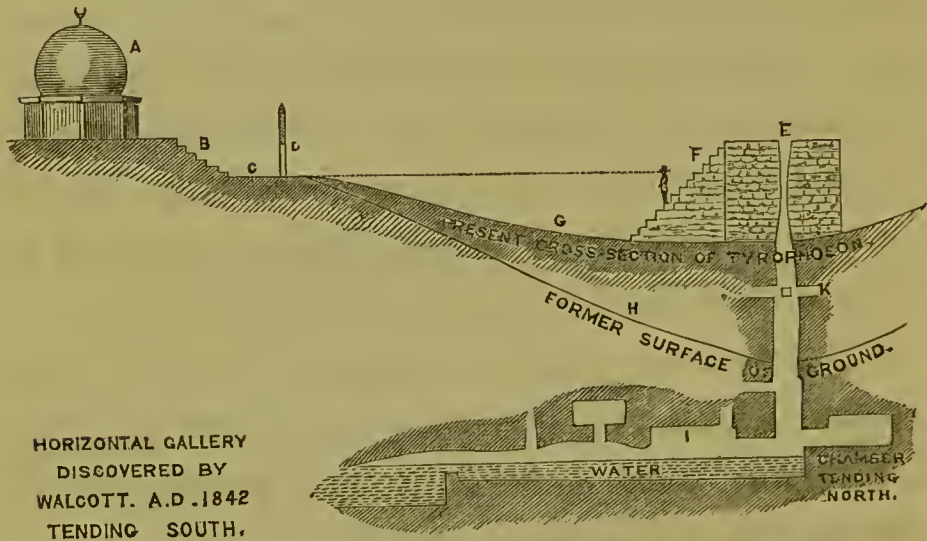
SECTION 5.

AIN HAMMAM ESH-SHEFA—THE FOUNTAIN OF THE
BATH OF HEALING.

The second is the Fountain of the Bath of Healing, in the Mill Valley, about 42 yards from the Haram wall, and south of the Cotton Bazaar—erroneously, in my opinion, supposed to contain a natural spring deep-seated in the earth. It is far more likely that it is a simple reservoir, constructed in the time of Solomon, or one of the earlier kings, when the city stood at a much lower level than it does now, especially in that vicinity, being part of a Valley, which has been greatly filled up.

This well or reservoir, whichever may be the proper appellation, till lately was not easy of access, for, being near a gateway to the Great Mosque, the exclusiveness of Islamism repelled the approach of Christians. By giving a present to the keeper, I was allowed freely to enter the premises. The shaft of the well is carried up like a chimney through the centre of a building, and the opening to it is upon the roof. I drew from memory, immediately on leaving the place, the following sketch, adapting it to the section of the well made from

measurement by Dr. Barclay. A represents the Mosque of Omar; B, the steps ascending to the platform on which it stands; C, the general level of the Haram enclosure; D, gateway to the Haram, wherein stands the Great Mosque; E, the mouth of the well; F, the steps leading up to it; G, the sloping side of the Mill Valley; H, the probable former surface of the ground; I, position of the horizontal gallery,



SKETCH OF AIN HAMMAM ESH-SHEFA, THE FOUNTAIN OF THE BATH OF HEALING, SHOWING THE PRESENT AND FORMER LEVELS OF THE GROUND, ETC.

with chambers, discovered by Mr. Wolcott, leading south; opposite to which is the opening to a chamber tending north. At K are four openings corresponding to the four cardinal points.

From the nature of this sketch, relative *positions*

only, and not *proportions*, have been necessarily attended to ; also, the gallery and chamber in the lower portion must be supposed at right angles to the upper.

As I ascended the steps F, and before my head reached so high as the roof of the building, the line of sight was on a level with the surface of the Haram grounds. The flight of steps are $18\frac{1}{2}$ feet in height. When at the top, I requested permission to let down a leather bucket by a line, to obtain some water ; and as I drew it up, measuring the line, ascertained the depth from the roof of the building to the surface of the water to be 82 feet. The depth of the water itself I had no means of measuring ; but as Dr. Barclay states the entire depth of the well to be nearly 85 feet, it must have been about 3 feet.

Mr. Wolcott, some years ago, descended by stealth during the night into this well ; and from his account, together with that of Dr. Barclay, who explored it subsequently, we learn that, from the bottom, a horizontal gallery, covered with loose stones, runs eastward, and connects with the well two chambers, placed at intervals along its length ; which, including the chambers, was, so far as they explored, $104\frac{1}{2}$ feet ; and, as I am inclined to think, it resembles

much the long tunnels, or "lodgments" as they are termed, for the accumulation of the water attached to the wells that supply the fountains in Trafalgar Square, in London, and other deep wells at home.

So far as anything is known of this mysterious fountain, descriptions of it by Mr. Williams, Mr. Wolcott, and Dr. Barclay, will be found in Appendix No. 2.

That it receives much of the leakage from the tanks and cesspools on a higher level, and much of the impure water thrown out from the houses, cannot be questioned; such liquids in Jerusalem, when filtered through the soil, are mistaken for spring water; and learned writers have even founded elaborate theories upon their peculiar "flavour." The process of filtration deprives them of all colouring matter, but not of salts and other noxious ingredients held in solution or chemical combination.

In addition to the water which this well receives from these impure sources, it is quite possible, as stated in Chap. I., Sec. 4, that it communicates by an aqueduct with some distant source, most probably a concealed spring at Ain es-Suâni, in the Valley of Jehoshaphat; the grounds of probability for this supposition are set forth in Chap. III., Sec. 1.

SECTION 6.

AIN SITTE MYRIAM—AIN UM ED-DURRAGE—THE
FOUNTAIN OF THE VIRGIN.

The Fountain of the Virgin is situate in the Ravine of the Kidron, at foot of the declivity south of the Haram : it is sunk like an artificial grotto into the rock, having a flight of about thirty steps leading down to the water.* Like the Fountain of the Bath of Healing, it derives much of its supply from the waste water, and leakage of the tanks, &c., in the city overhead ; the remainder is derived from the Mount of Olives, and the side of the Kidron Valley next the city, both of which are crowded with tombs.

The portion of the Kidron Valley above the Fountain of the Virgin to Ain es-Suâni is known more particularly as the Valley of Jehoshaphat. In it, according to Jewish belief, the Messiah has ap-

* The water springs up at the bottom of an artificial cave, some 25 feet deep, excavated in the rock of Ophel. Descending by a flight of 16 steps, we reach a chamber 18 feet long by 10 wide, and 10 high ; its sides built of old stones, and its roof formed of a pointed arch. Then going down 14 steps more, we reach the water.—*Professor Porter.*

There are 26 steps, making the depth about 25 feet, for the steps are deep.—*Mr. Williams.*

pointed to judge the world at the last day. Jews, therefore, from all parts of the earth flock thither in their old age, that they may be buried in so sacred a spot; and consequently the base of the Mount of Olives, along the edge of this valley, is the great cemetery of the Hebrew race; whilst the opposite side of the valley, under the walls of Jerusalem, which is one of the sacred cities of Mahomet, and in Arabic named Beit el-Makhuddis, the House of the Holy Dwelling, or sanctuary—abbreviated into El-Khuddis, or El-Kuds; *par excellence*, THE HOLY—is covered with the graves of devout Moslems; their belief being that when time shall end, Mahomet will there sit in judgment, upon a certain stone which is pointed out in the Haram wall overlooking the valley.

Consequently, from both sides, through graves and sepulchres occupying acres in extent, the water must percolate which reaches from *without* the city the Fountain of the Virgin.

It has, therefore, been shown that every source is corrupted from which this well can receive its natural supply. Professor Porter, in speaking of it, expresses himself thus: “The taste of the water is peculiar, but it differs at different seasons; towards the end of

summer, when low, it becomes brackish and disagreeable." Dr. Robinson also gives a similar description of it. But, whilst they appear to regard it as a spa, or mineral spring, it is clearly manifest that the *peculiar taste* arises from organic abominations dissolved in the water.

On stating my views upon this subject to the Rev. Albert Augustus Isaacs, of Corpus Christi College, Cambridge, author of "Pictorial Tour in the Holy Land," he told me that Mr. T. Seddon, the artist, returned home sick from Jerusalem, and consulted Dr. Simm, of Edinburgh, who was connected with the Jews' Society. Dr. Simm, on examining him, at once said, "What water have you been drinking? Bad water has been the cause of your disease." To which he replied, "The water of Siloam, and of the Fountain of the Virgin, at Jerusalem; and I liked it very much." "Well," added Dr. Simm, "it must be bad water." This fact, which I heard since the foregoing was put in type, and several copies of the work circulated among the members of the Syrian Improvement Committee, and others, presents a practical corroboration of what I have otherwise by inference and deduction proved—namely, that the so-called water of this misnamed fountain is totally unfit for the use of human beings.

How Mr. Seddon could have "liked it very much," is easily explained, by his having got an "acquired taste," as people acquire a relish for the slightly brackish water of Leamington, to which I thought it very like, the only time I prevailed on myself to taste it, which was early in the season, before water had become scarce; and, consequently, while the impurities were in a diluted state.

At irregular periods, more frequent in winter than in summer, the water in this well presents a hitherto unaccounted-for phenomenon, rising suddenly for a few minutes at a time beyond its normal limits—an effect attributed by pilgrims to miraculous agency.

It may possibly be accounted for on the principle of natural intermitting fountains, of which there are several in Syria; but if it be true, as stated, that without any hydrometric change, or variation of temperature, &c., the intervals between the flows are extremely unequal, it would be difficult to account for it on any received theory of the nature of intermittent springs.

It is said that the intermissions seem to follow no rule whatsoever dependent on the seasons, or the rainfall; save this one, that the abnormal flows occur

more frequently after a season of much rain than at other times; but that might arise from there being then more water supplied to the great cistern: and it does not in the least account for the fact, if so it be, that after the winter rain has ceased, and the rainless season set in, the flows take place, even then, at no regular intervals; sometimes occurring five or six times in one day, and then not at all during the succeeding five or six days; again occurring several times in a day, without any fall of rain, change of temperature, or other apparent physical cause. The short intermissions of one or two hours are quite incompatible with the action of a natural syphon; which, when once set in action, could not cease to operate till all the accumulated water of the preceding interval of rest, whether of long or short duration, had been discharged. A series of accurately registered observations upon this fountain are most desirable, and might lead to some clue to the mystery.

A very simple solution of the question appears to lie in this: Between the well and the great reservoir beneath the Haram a connexion exists by means of the drain which Mr. Williams announced to the Royal Institution as lately discovered by Dr. Pierotti; previous to which I had reported to the Syrian Improve-

ment Committee that I thought it probable there was a connexion between them; for the reservoir must reasonably be supposed to possess some outlet, otherwise it would formerly have been liable to cause inundations in the Temple, when the aqueduct from the Pools of Solomon, and probably also other aqueducts, poured a continuous stream into it; and the sudden increase of water in the well may, at the present day, be accounted for by supposing that the Moslem attendants on the service of the Mosque occasionally make use of the outlet to discharge waste or superfluous water.

But if this be the true solution of the problem, we are placed under the necessity of supposing that one of Herod's or Pilate's aqueducts, spoken of in Secs. 11 and 13 of this Chap., even now supply the reservoir beneath the Haram. Otherwise, it being capable of containing only about two million gallons, as stated in Sec. 2 of this Chap., it could not furnish anything like the amount of water yearly expended in the abnormal flows of the fountain.

If the account mentioned in the concluding Sec. of this Chap. be true respecting an aqueduct from Hebron, made by the Mameluke Sultan Kaitubai; or if the report be true, as mentioned there also, that a

stream enters the city beneath the Damascus Gate, on the supposition that either of these has a connexion with the Fountain of the Virgin; and upon the further assumption that the stream conveyed by it is not a constant, but an intermitting one—the irregular flow of the Virgin's Fount may be explained.

Whenever this rising of the water takes place, a stream is observed to gush into the well from the bottom, and also from underneath the lower step leading down to it.

The following extract from a paper by the Rev. George Williams, B.D., Senior Fellow of King's College, Cambridge, read before the Royal Institution of Great Britain, in February last, gives a very lucid account of the important recent discoveries of Dr. Pierotti—an account of which I had heard when at Jerusalem; and since then have been told of them more circumstantially by Dr. Barclay; but Mr. Williams has expressed all so concisely, and at the same time so intelligibly, that I cannot do better than give his words:—

“The chief interest that attaches to the discoveries lately made at Jerusalem by Signor Pierotti—corroborated, as they doubtless will be, in all main points, by the still more recent investigations of the Count de

Vogüé and M. Waddington in the course of last year—is derived from the remarkable confirmation which they afford to the received views of the topography and archæology of the Holy City, in the case of those sites which are of greatest importance in connexion with its sacred history. I gratefully accept all the facts brought to light by Signor Pierotti, while I differ considerably from his inferences and conclusions. Here I shall state my own views, without entering into controversy.

“As it would be impossible to do justice to all these discoveries in the course of a single lecture, I propose to confine my remarks to the site of the Temple and its contiguous fortress, Antonia. The situation of the former appears to be fixed beyond all possibility of doubt by the recent discovery by Signor Pierotti of the complete water system connected with the Hebrew Temple, still existing as entire as when it was in daily use during the period of the Jewish commonwealth. The perfect preservation of this complicated system of aqueducts, drains, and reservoirs, is owing to the fact that they are all excavated in the solid rock, and therefore have not been affected by the demolition of the structures above, except so far as they may have become partially blocked up by the accidental falling in of the *débris* of the ruined buildings.

“Had history been silent on the subject, yet we should have been forced to conclude, from the account of the various sacrifices connected with the Jewish ritual, especially from the description of the numerous victims offered by Solomon at the Feast of Dedication, that there was a very complete system of sewerage connected with the Temple, introducing a large quantity of water to dilute the blood, which would otherwise have had a tendency to coagulate, and carrying off the blood and offal from the sacred precinct.

“This, history tells us, was actually the case. The fullest account which is preserved of these water-works is contained in the description of the Holy City and of the Temple worship, in a tract of Aristeas, who visited Jerusalem during the reign of Ptolemy Philadelphus, and who describes a vast series of reservoirs beneath the area of the Temple, supplied by a copious spring of living water, and connected together by pipes and conduits extending over a space of five furlongs. There were many openings to these hidden depths from the area above, the secret of which was known only to the ministers of the Temple ; and the supply of water was so managed as to flush the whole court, and carry off the blood of the numerous sacrifices.

This description is fully confirmed by the Mishna and other Jewish authorities.

“This language, which might formerly have appeared exaggerated, is now proved to be literally correct; for those cisterns have been actually explored, and the conduits and drains traversed in all directions by Signor Pierotti; so it is no more matter of conjecture, but of ascertained and positive fact.

“It was the happy suggestion of Professor Willis, and a striking example of that marvellous intuition for which he is so remarkable in investigations of this nature, that the hole in the Sacred Rock of the Moslems, under the well-known Dome of their Mosque, and the cave in that rock, now so familiar to all from the frequent descriptions of many travellers, but especially from the drawings of Mr. Catherwood, were the drain and cesspool of the Jewish altar; and that the round hole in the centre of the rocky pavement of that cave was the mouth of the channel by which the blood, poured out at the horns of the altar, flowed off, according to the Mishna, to the Valley of the Kidron. That theory of Professor Willis really implied the condition that, if ever the hollow in the rock under that circular stone should

be explored, there would be found an aqueduct for bringing in a supply of water on one side, and a drain for carrying off the blood and water on the other side. Now such is really proved to be the case; and Signor Pierotti has actually entered that lower cave by one channel, and quitted it by the other.

“The supply of water, which no longer flows in these channels, owing to various obstructions, was derived from the celebrated Pools of Solomon on the road to Hebron, south of Bethlehem, and was brought to Jerusalem by an aqueduct which still exists. It crosses the Valley of the Tyropœon by the artificial embankment which joins Mount Zion to the Temple Mount—the *Bridge* of the Jewish historian. It was then received into a well sunk in the rock, immediately in front of the Porch of El-Aksa, from whence it was distributed according to the exigencies of the Temple worship; for the supply could be regulated according to the requirements of the season. The channel for the supply of the Temple ran northward from this well, under the wide causeway which leads from the north door of El-Aksa to the south gate of the Dome of the Rock, passes under the stairs opposite the Gate of

Prayer, and so through the rock of the raised platform into the lower cave, as already described, which marks the site of the altar of the daily burnt-sacrifice. When this is once ascertained, the whole Temple can be laid out, with the help of the tract Middoth (Measures) in the Mishna; and it is a curious and interesting fact, that when the various parts of the Temple are distributed and adjusted according to these measures, the interval between the western wall of the Holy of Holies and the boundary-wall of the inner Temple is exactly what it ought to be, supposing the western limit of the inner Temple to correspond with that of the raised platform of the Haram, which, as being cut in the live rock, has probably remained unaltered from Jewish times.

“The drain from under the Jewish altar then runs northward for a distance of 120 feet, to a large double cistern, hollowed in the rock of the raised platform of the Haram. The Jewish authorities inform us, that the place where the victims were slaughtered, the hooks to which they were hung for the purpose of being flayed, and the marble tables on which they were dressed, and the parts appropriate for the sacrifice separated and prepared, was to the north of the great altar. Here, therefore, would be the greatest effusion

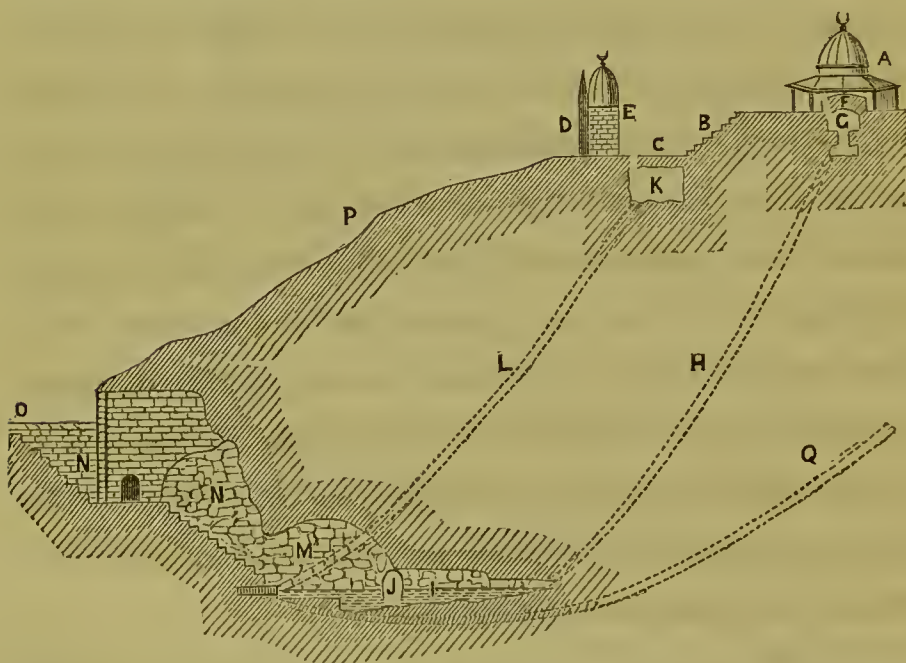
of blood and other matter connected with the slaughter of the beasts ; and here, accordingly, were these large receptacles, with an arrangement for a fresh supply of water coming in from the west, the source* of which has not yet been fully investigated.

“ From this point the sewerage took an easterly direction, and ran through a triple rock-hewn tank under the lower area of the Temple, about half way between the raised platform and the eastern wall, where it was further diluted by a fresh supply of water introduced by an aqueduct from the enormous tank outside the northern wall of the Temple Close, known as the traditionary Pool of Bethesda. The drain then passes under the wall of the Haram, and skirting it on the east side, along the narrow ridge now occupied by a Moslem burial-ground, descends steeply to the Fountain of the Virgin, in the Valley of the Kidron, where, according to the Mishna, this sewerage from the Temple was disposed of as liquid manure to the market-gardeners.

* It may possibly have been a branch from the Aqueduct of Hezekiah, referred to in Chap. II., Sec. 4 ; of Herod, referred to in Sec. 11. ; of Pilate, referred to in Sec. 12 ; or of Sultan Kaitubai, mentioned in Sec. 19 ; but this is pure speculation. The question requires proper investigation, which I hope to give it on my next visit to Jerusalem.

“So much of the water from Solomon’s Pools as was not required for the use of the Temple flowed off from the well in front of El-Aksa to an enormous rocky reservoir, called the Royal Pool in the Chronicles of the Crusades : from whence it ran by a channel traced by Signor Pierotti to the same Fountain of the Virgin.”

On the accompanying Sketch I have shown the position of the Mosque of Omar, with respect to the



SKETCH OF FOUNTAIN OF THE VIRGIN, SHOWING ITS POSITION WITH RESPECT TO THE HARAM, THE JEWISH TEMPLE, AND THE MOSQUE OF OMAR.

Fountain of the Virgin. The relations to each other of the several objects will be understood by the lettered reference : A, Mosque of Omar ; B, steps

ascending to platform on which it stands ; c, the general level of the Haram enclosure ; d, southern wall of same ; e, Mosque el-Aksa ; f, the Sakhras, or Holy Rock, over which the Mosque was reared, named from it by the Moslems Kublet es-Sakhras (Dome of the Rock), and on which the Altar of Burnt Sacrifice of this Jewish Temple is by many supposed to have stood ; g, the cave underneath it ; h, the sewer from receptacle below the cave to the Fountain of the Virgin, discovered by Dr. Pierotti ; apparently that mentioned in the Mishna by Rabbi Akaba ; i, enlarged opening visible at the Fountain of the Virgin ; j, entrance to tunnelled conduit leading to the Pool of Siloam ; k, " Great Reservoir " beneath the Haram, mentioned Chap. II., Sec. 2 ; l, drain from same to Fountain of the Virgin, also discovered by Dr. Pierotti, and confirmatory of my theory as to the cause of the increase of water in the Fountain at uncertain times ; m, Fountain of the Virgin ; n n, steps leading down to it ; o, surface of Kidron Valley ; p, surface of Mount Ophal ; q, possibly the termination of one of Hezekiah's, Herod's, or Pilate's aqueducts, or that of Sultan Kaitubai, or others, mentioned in the foregoing part of this Sec., to account for the intermittent flowing of the water.

As is the case with the Sketch of the Fountain of the Bath of Healing, in Sec. 5 of this Chap., relative position, and not accurate proportion, is only shown, being all that is necessary for the purpose. Without distortion of some of the parts, it would be impossible to delineate each object with distinctness in so small a compass. From it, it may be seen how easily the sewage from the Jewish Temple, which occupied the site of the present Mosque of Omar, could have been discharged into the pit which is now called the Fountain of the Virgin, and which I never doubted, from the first moment I saw it, was sunk to receive the offal from the Temple, or the city overhead, or both, for I observed at once that little or no water could ever have got into it, except by a direct discharge from sewers, or by leakage from them and from reservoirs overhead. I formed this opinion, and mentioned it to Dr. Stanley, before I left Jerusalem; and what Mr. Williams says in the foregoing extract quite bears it out. Professor Willis, it appears, likewise formed a conclusion in part the same. He supposed that the offal from the Temple flowed by a sewer downward to the Kidron; but he does not appear to have supposed that the Fountain of the Virgin was the receptacle for it.

Rabbi Akaba, writing in the Mishna, says, "There was a certain cave beneath the altar, whereby filth and uncleanness were carried down into the Valley of the Kidron, and the gardeners paid so much money as would purchase a trespass-offering for the privilege of fertilising their gardens with it."

As a matter of course, a cesspool in the Kidron was necessary to receive the sewage, else how could it have been got together for the purpose of sale to the market-gardeners? and Dr. Pierotti's discovery sets it beyond all doubt that it was the pit which now bears the name of the Fountain of the Virgin, where the sewer from the present Mosque terminates, which was undoubtedly the sewer from the ancient Temple.

It is also worthy of remark that the word Kidron, the name which the valley bears, means *filthy*: the place was called so, apparently, from this cesspool and manure traffic being in it. The operations carried on there were similar to the utilization of the manure which I have recommended, but at a greater distance from the city, in Chap. VI., Sec. 4, where some statistics are given as to the great value of sewage in agriculture.

SECTION 7.

AIN SELWAN—SILOAH—POOL OF SILOAM.

A conduit tunnelled in the rock conducts the out-flow from the Fountain of the Virgin to the traditional Pool of Siloam, 340 yards lower down the valley; an interesting description of the exploration of which, by Dr. Robinson, will be found in Appendix, No. 3. The water is first received in a small artificial cave sunk in the rock, beneath the impending brow of Ophel, from which it flows through a cleft channel, a few yards in length, into the Pool; an oblong receptacle, 53 feet in length by 18 in width, and 19 deep, having its sides partially raised near the top. The Pool is altogether much out of repair, and the depth of water is regulated by a dam of weeds and earth. The stream flows through it, and continues to a point a little further on, where the poor people of the adjoining village of Siloam wash their clothes, &c., before it enters a small tract of cultivated land, called in Scripture the King's Gardens, now used for the growth of vegetables, in which it is divided into small channels for purposes of irrigation, till at length, being absorbed in the ground, it is again partially collected in En Rogel.

It is a necessary consequence of the Fountain of the Virgin having been originally a cesspool—and, if that be admitted, a fact incapable of being controverted—that the Pool of Siloam (now so-called) was likewise a cesspool, formed for the purpose of receiving the liquid from the upper cesspool, in order that the manure in it might become sufficiently desiccated to be in a fit state for removal by the gardeners who purchased it, and that the tunnelled conduit was that through which the moisture was drained off into the lower cesspool, or liquid-manure tank.

I consider this cesspool, under the rock of Ophel, to have been quite distinct from the Pool of Siloam proper; called also, as we shall presently see, the Lower Pool, which was near the King's Gardens, and is distinctly described in Nehemiah iii. 15, as "*The Pool of Siloah, by the King's Garden.*" It is also mentioned in Isaiah xxii. 9, as "The Lower Pool;" and again, in verse 11 of the same chapter, as "The ditch between the two walls;" and to bear all this out, there actually does exist at the present day the distinct traces of a pool in the identical place which would best correspond with each of these notices. I shall give the description of it by Dr. Barclay, as in all

cases, when possible, I wish to adduce the testimony of others to bear upon my views:—

“DITCH BETWEEN THE TWO WALLS”—“TRENCH”—MIKVAH—RESERVOIR.—The depressed garden occupying all the gorge between the promontories of Zion and Ophel, except space barely broad enough for a road on each side, is obviously the site of an ancient pool, probably that of the “Lower Pool” of Isaiah, where the expression “gathered together” would be more significant than elsewhere. It was about one hundred and thirty feet long, and about the same in breadth, but evidently somewhat curved at the northern end, leaving an interval of only a few paces between it and the Pool of Siloam. That a large pool existed here till a comparatively late period, is evident from the accounts of pilgrim tourists. It would seem not improbably to be identical with the “Lower Pool” (Isaiah xxii. 11). The precise meaning of “Mikvah” is “a place where waters flow together,” a term exactly indicative of the character of this lowest of all the pools of Jerusalem, where all the waters of the city literally flowed together.

Now, in the face of all these facts and descriptions—and also looking at it as an engineer, independently

of all descriptions and written notices, and considering only the nature and appearance of the ground and physical circumstances—my conviction is, as before said, that the Fountain of the Virgin and the so-called Pool of Siloam were both cesspools ; one intended to retain the solid and the other to receive the liquid manure cast out from the Temple, and perhaps also from the city—from which sewers may likewise have existed, and probably do so still ; and that the present clearness of the water in the Fountain of the Virgin, and in the Pool of Siloam, is accounted for by these sewers being stopped up with matter, and thereby rendered unserviceable.

As to the true Pool of Siloam, I consider that it was what is in another place called the “Ditch between the two walls,” and was identical with that the ruins of which are now included in the fig-garden above mentioned, the extent of which is about half an acre. The accompanying Map shows the probable course of the ancient wall, and, if it be correct, which there is strong evidence in favour of, the Pool lay in an angle between two portions of the wall—one on the north, upon the embankment between it and the present so-called Pool of Siloam ; and the other on the south : therefore with propriety it may be said

to have lain between two walls. A natural reason for the wall to have taken so tortuous a course at this place is this : To effect the double purpose—first, of including the “Lower Pool,” which Josephus said had “*sweet water* :” and, second, of excluding that which was a cesspool, and would have been an offence within the walls.

The curvature which in this place I have given to the wall, for a sufficient reason, is similar to that which it will be seen, on referring to the Map, Mr. Thrupp has given to his wall at the north of the City, for the purpose of excluding a depression in the land. Therefore, in giving a sharp local curvature to the wall, I am not without precedent. But I have also the authority of Tacitus to bear me out; whether to the full extent or not, is the only question. He states that the walls which enclosed the city were in some places built purposely oblique, and in others that they receded with an inward bend. (“*Nam duos colles immensum editos, clandeabant muri, per artem obliqui, aut introrour sinuati.*” Hist. V., 11).

Furthermore, Nehemiah distinctly says that the city wall went round the Pool of Siloam, when he mentions part of it as “the wall of the Pool of Siloah, by the King’s Garden” (Nehemiah iii. 15), for the

wall of any thing is ever that which encloses it. The Mishna likewise states that Siloah was within the city.*

Independent of the above argument, it follows, from the words of Josephus, that the name of the Pool of Siloam is now misplaced. He states distinctly that it contained *sweet* water: whereas, it has been shown above that the pool to which the name attaches must at that time have contained liquid sewage, and that, at the present time, it contains very unwholesome and extremely impure water; though, to the palates of some, who have acquired a taste for brackish water, it may appear *sweet*: such as Mr. Seddon, mentioned in the foregoing section, who declared "he liked it very much;" although, as it subsequently appeared, it made him ill.

The quality sweet or bitter being solely a matter of sensation, which varies in different subjects, its presence or absence cannot be brought under absolute demonstration; whilst the existence or non-existence in water of saline, earthy, or organic impurities, can be undeniably proved.

The following is the passage from Josephus which

* Jerus. Chagigah., fol. 76—11, quoted by Dr. Lightfoot Chor. Cent., xxv. 5.

mentions the Pool proper of Siloam as containing sweet water : “Now, the Valley of the Cheesemon-gers [the Tyropœon], as it was called, was that which we told you distinguished the hill of the Upper City from that of the Lower ; extending as far as Siloam, for that is the name of a fountain which had sweet water in it, and this in great plenty also.” (Wars V., IV., 1—2.)

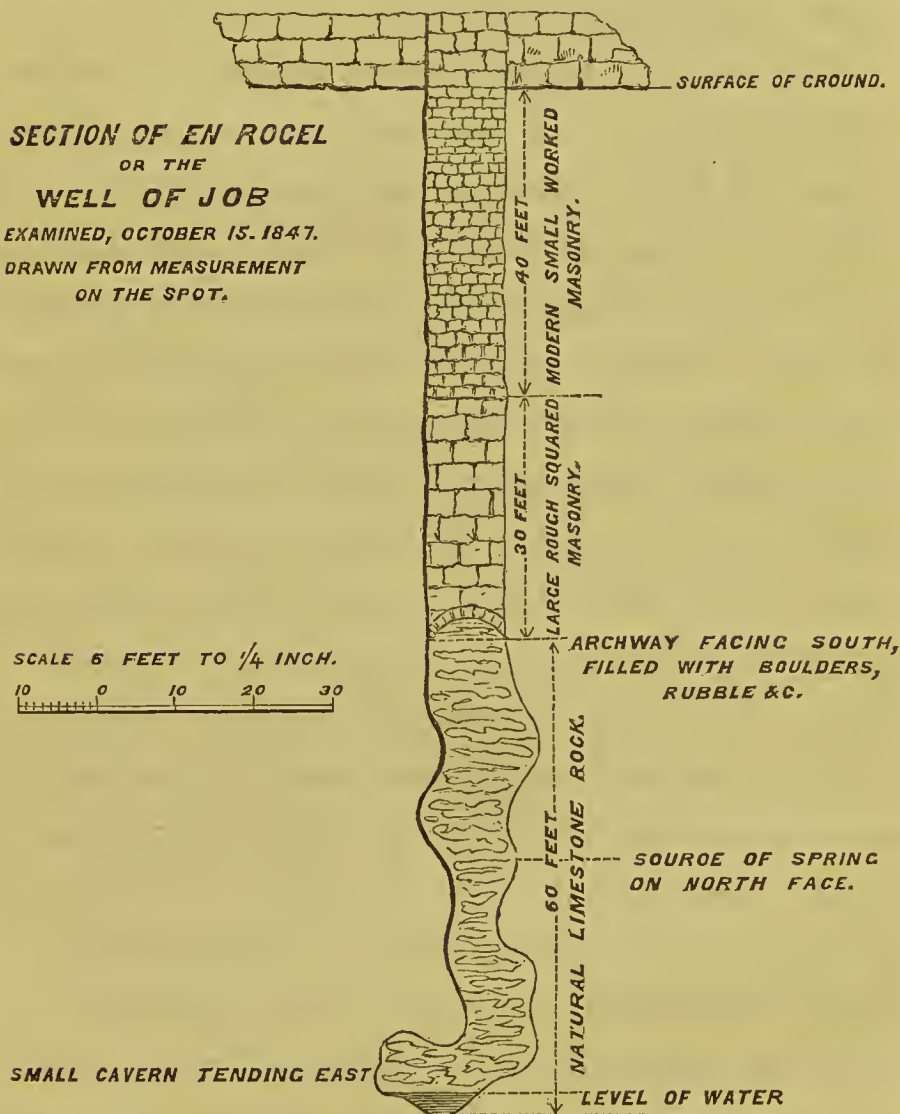
We know, also, that Christ would not have sent the blind man, as mentioned in John ix. 7—11, to wash in any but clean water. And Isaiah viii. 6 mentions “The waters of Shiloah that go softly,” intimating most strongly that those of the Pool of Siloam proper—*i.e.*, the Lower Pool—were pure. (See a short notice on the subject in Chap. I., Sec. 4.)

SECTION 8.

BIR YUAB, OR EYUB—EN ROGEL—WELL OF JOB, OR JOAB.

En Rogel, called also the Well of Job, is mentioned in the Bible in several places. It was specified by Joshua as a point on the boundary line between the tribes of Judah and Benjamin. Here Adonijah assembled his retainers when he aspired to usurp the throne of his father David.

Through the kindness of Mr. Finn, late British Consul at Jerusalem, now transferred to the Darda-



SECTION OF EN ROGEL, OR THE WELL OF JOB.

(Copied from the original by permission of Mr. Finn, Her Britannic Majesty's late Consul at Jerusalem.)

nelles, I was enabled to get the accompanying section of this well, showing the different strata through

which it passes, with measurements on each, taken in October, the driest season of the year, when it contained scarcely any water.

This well, of Sacred-historic interest, as appears by this section, is 130 feet deep, situate immediately below the King's Gardens, near the point where the Valley of Hinnom unites with that of the Kidron. It overflows in winter after heavy rain, but in summer is almost entirely dependent upon the scanty and tainted stream which originates at the Fountain of the Virgin, and which, after having been further polluted by the washing of clothes and household articles near the Pool of Siloam, in part percolates into this pit, through the mould in the vegetable gardens, to be again conveyed to the city in rank goatskins, where, having been used by the inhabitants, it retraces its way to En Rogel—diminished in quantity by subsidence into the earth, but also partly by evaporation, and consequently the impurities in a more concentrated state, the ratio increased as it must be conversely to the volume of water—again and again, having been but slightly diluted in the well, to be reconveyed to the city, each succeeding time more unfit for the use of human beings; till at length, the winter rain having set in, the well over-

flows with good water, when it is least required. For particulars on this head, see Chap. I, Sec. 4; where also is given a drawing of the building over the well.

Mejr ed-Din, an Arab historian, author of the "Ins," narrates that he had seen the following account of this well in the writings of Ibn Omár, son of Mohammed el-Kasem: "I have read in history that, in a drought of water, this well was dug to the depth of eighty ziraas (cubits), ten long, and four wide. This well is entirely cased with large stones, each of which is five ziraas long, and two high, more or less. I was astonished at the size of these stones, and at the difficulty of getting them down there. The water was fresh, and during the whole year at the depth of eight ziraas, except in the winter, when it overflows, inundates the valley, and turns a mill. I descended into the well with the labourers to dig there. I saw that the water there issued from a stone of nearly two ziraas [in diameter?]. There is a cave, the entrance to which may be three ziraas in height, by one and a-half in width. A very cold wind comes from this cave. I entered it with a lighted candle, and saw there a cave all in stone; I advanced, but the wind which issued thence extinguished the candle. The well is in the depth of the valley, and the cave

in the middle of the well, which is surrounded by enormous rocks and high mountains, up which one climbs with difficulty. This is the well whereof God said to Job, 'Place thy foot in this cold hole.'"

The cave mentioned by this Ibn Omar appears to correspond in position with the very remarkable archway shown in the foregoing section, as now stopped up with boulders and rubble. The arch may be of comparatively modern construction, or it may contain within it the entrance to the cave which he describes as about three ziraas in height, by one and a-half in width, which may be a natural fissure in the rock, or it may have been formed artificially for some 'strange purpose. I hope on my next visit to Jerusalem to be able to explore it, and clear up this very interesting question—now raised for the first time—by the publication of the section. The large stones shown in the section answer tolerably to Ibn Omâr's description.

Could the cave at the present bottom of the well—shown in the section—be that which Ibn Omar speaks of? It might be so, on the supposition that the well was formerly deeper than at present, and that it is one-half filled up with rubbish, so that the cave at the present bottom was formerly (as he describes) "in the middle of the well." This point could be

easily decided by the boring-irons. He could not mean that eighty ziraas was the total depth of the well; for it is more than that even now. His meaning must be that, in a certain time of severe drought, it was deepened by that much.

SECTION 9.

BIRKET EL-MAMILLA—UPPER POOL OF GIHON.

The Upper Pool of Gihon, before mentioned (Chap. I., Sec. 4, and Chap. II., Sec. 4), from which a small drain or aqueduct, beneath the surface of the ground, leads to the Pool of Hezekiah, is situate towards the head of the Valley of Hinnom, 672 yards N.W. of the Jaffa Gate. According to Dr. Robinson, it is 316 feet in length by 209 in breadth, and 18 deep, containing therefore 1,188,792 cubic feet. It seldom retains water throughout the year; and at best times, in summer, it yields a very inconsiderable amount.

SECTION 10.

BIRKET ES-SULTAN—LOWER POOL OF GIHON.

The Lower Pool of Gihon lies further towards the south in the same valley, 138 yards west of the S.W. angle of the city wall, and 750 yards in a direct

line from the Upper Pool, close to the beautiful Terrace, built as a Jewish Hospital by the munificence of Sir Moses Montefiore and the late Mr. Judah Tauro, a wealthy Israelite of New Orleans : its length is 592 feet, and mean breadth 260 ; at the northern end it is 35 feet deep, and 245 wide ; and at the southern 42 deep and 275 wide. It is partly sunk in the natural rock, and partly formed of masonry ; at the sides it is not so deep as along the centre line ; and at the southern end it is altogether much deeper than at the other. It contains no water, from want of drains to intercept and convey the rain from the surrounding district.

SECTION 11.

EL-BURAK—POOLS OF SOLOMON, AND AQUEDUCTS OF SOLOMON AND HEROD.

About seven miles in a direct line from the Haram enclosure, beneath which lies the great cistern which was formerly supplied by an aqueduct from these pools, and two miles S.W. of Bethlehem, are the Pools of Solomon. They are three in number, and formed in a precisely similar manner to the Lower Pool of Gihon, partially by embankment across a

valley, and partially by excavation in the natural rock; all being rendered staunch by masonry and cement.

A view, copied from a photograph, taken from the *only* position from which a glimpse of the Lowest Pool can be obtained, together with the other two, is given in a compilation, called "Scripture Topography," edited by the Rev. Arthur Augustus Isaacs. A portion only of the Upper Pool is shown, and therefore the large fortified Khan, which stands at the N.W. angle, is omitted. This view of the pools is the only perfectly accurate one I have seen in any publication.

The following table, deduced from the measurements of Dr. Robinson and others, gives the average dimensions and approximate capacity of each pool:—

FIRST, OR UPPER POOL.

	Feet.	
Length . . .	380	} Capacity, $380 \times 232\frac{1}{2} \times 18\frac{1}{2}$. Equal 1,634,475 cubic feet.
Average breadth .	$232\frac{1}{2}$	
Average depth .	$18\frac{1}{2}$	

SECOND, OR MIDDLE POOL.

	Feet.	
Length . . .	423	} Capacity, $423 \times 205 \times 29\frac{1}{4}$. Equal 2,536,414 cubic feet.
Average breadth .	205	
Average depth .	$29\frac{1}{4}$	

THIRD, OR LOWER POOL.

	Feet.	
Length . . .	582	} Capacity, $582 \times 177\frac{1}{2} \times 37\frac{1}{2}$. Equal 3,873,937 cubic feet.
Average breadth .	$177\frac{1}{2}$	
Average depth.	$37\frac{1}{2}$	

The second pool is distant from the first 160 feet, and the third from the second 248 feet, thus the three pools, with the spaces between them, occupy the valley for a length of $597\frac{2}{3}$ yards, or more than one-third of a mile, and are capable in the aggregate of containing 8,044,826 cubic feet of water, equal to 50,136,320 gallons.

These pools receive a large supply of water from the drainage of their catchment-basin, an extended district of upland country, capable of yielding, under a perfect drainage system, a much greater quantity of water than the pools would be able to contain.

A considerable portion of the water which the district at present yields is derived from a covered spring, supposed to be the identical "spring shut up," the "fountain sealed," alluded to by Solomon in Canticles iv. 11, 12; about thirty feet under ground, and two hundred yards to the west of the Upper Pool, from which spring part of the water runs directly into the Upper Pool at the N.W. angle, and the remainder

is conducted by an earthenware pipe along the northern edge of the pools. It is so arranged that, when occasion requires, the water of the second and third pools may be augmented by branches leading into them from this pipe, which eventually unites with the main aqueduct, which, as mentioned further on, commences at the Lower Pool.

The overflow of the first pool falls into the second, and that of the second into the third, from which an aqueduct strikes off, and follows the winding of the hill sides, till it reaches Bethlehem, where at present it delivers *all* the water for the use of the village and the irrigation of its gardens. It then continues a tortuous course till it arrives at Jerusalem, and terminates within the Haram, at the great cistern, as before mentioned (Sec. II. of this Chap.), which it formerly supplied with water. Perhaps it is this aqueduct which is thus referred to in the Scriptures: "There is a river, the stream whereof shall make glad the City of God, the holy place of the Tabernacles of the Most High." (Psalm xlv. 4.) In all its windings, it is twelve and a quarter miles in length; though the direct line between its extremities is only six miles and seven furlongs, as measured from Dr. Barclay's original Map, which he

kindly lent me, on which all the turnings are laid down; and which, with permission, I have copied, in marking its course on the accompanying Map.

There is but little doubt that this aqueduct occupies the course of the original one (most probably constructed by Solomon), which having, in the lapse of time, become dilapidated, was repaired, or perhaps reconstructed, by Sultan Mohammed Ibn Kelaûn, between A.D. 1294* and 1340, in commemoration of which a tall monumental fountain—to which the aqueduct sends off a branch—stands on the southern embankment of the Lower Pool of Gihon, at the road side which crosses the ravine upon the embankment. It bears upon a tablet the following inscription, as translated by Dr. Schultz, late Prussian Consul at Jerusalem: “In the name of the most merciful God, our Lord the Sultan, el-Melik en-Nasir, the Lord of the Faith and of the Faithful, Mohammed, son of Sultan el-Melik en-Massûr Kelaûn, ordered this blessed aqueduct to be built.” The tablet is unfortunately mutilated at the place where the date should have been; but from Mr. Williams† we learn that “Sultan Mohammed Ibn Kelaûn, one of

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PLAN

SHOWING COURSE OF HEROD'S AQUEDUCT

AND ALSO THAT OF SOLOMON

From the Pools of Solomon to Jerusalem



John Irvine Whitty C.E.

March 1863

the Baharite dynasty in Egypt, reigned between 693 and 741 of the Hegira," corresponding to the above-named period of the Christian era.

Such inscriptions abound throughout Syria, and often ascribe the credit due to the original constructor to him who merely repaired a work, or, at most, reconstructed it. In this case it is probable that Sultan Mohammed only repaired the old aqueduct of Solomon, and laid the present earthenware pipes in that which had formerly been, perhaps, an open channel. The earthen pipes are not continuous in the present aqueduct, some portions of it being formed only of masonry, cemented on the inside and covered over, whilst other portions are formed by an eight or nine-inch pipe, encased with stone-work: it lies beneath the surface of the ground, having, at intervals, openings through which water might be drawn up. Beneath the village of Bethlehem it runs through a short tunnel, and likewise through a second tunnel about a mile and a quarter from Jerusalem.

The last repairs recorded as having been done to this work were in the sixteenth century, by the Ottoman Sultan Suliman, surnamed the Magnificent; by whom also were built the present city walls, of very imposing appearance, being, on an average, about

forty feet in height, and, as Dr. Barclay says, in some places, including the embrasures, fully double that. I myself measured the thickness in several parts, and found the average to be eleven feet for about one-half the height, to the first offset on the inside; for though altogether perpendicular on the exterior, as the height increases they recede on the interior by offsets—two, three, or four in number—which served as stands for the soldiery.

A little eastward of the Lowest Pool of Solomon, near its commencement, the aqueduct receives a considerable accession of water, beyond that which it derives from the pools themselves, or through the pipe from the "Fountain Sealed," which, commencing at the fountain, skirts them on the north-east. This increase is due to a duct which, coming from a southerly direction, enters the main aqueduct at the point spoken of; but before doing so the stream it conveys is augmented by one from a fountain within a vaulted chamber beneath the eastern embankment of the Lowest Pool. This fountain is upon the same principle as the "Fountain Sealed," at the head of the first pool, and is supplied by two streams—one issuing from the earth beneath the pool itself (which I think probably depends in some degree upon the

leakage from the pool overhead), and the other coming through a side channel from a source outside the pool, possibly from another well similar in character to the "Fountain Sealed;" for these hidden springs are by no means uncommon throughout the land, the concealing of sources of water, so far as possible, having been necessitated by the turbulent spirit of the age.

At Dier el-Benât, about three-quarters of a mile south-west of the pools, is one of these concealed springs, which, as I have not seen it more than alluded to by any traveller—though the locality is marked on some maps—I shall describe from memory, having visited it last year with Mr. Alexander Finn and Mr. Peter Masholm.

Ain Dier el-Benât—named after the adjoining ruined village, and also called the "Fountain of the Daughters of the Haram," because there Solomon is said to have kept some of the female members of his establishment, as he is said to have kept his foreign wives at Siloam—lies near the head of a small wady, entering Wady Taheishimeh from the west, and for centuries attracted no particular attention. It supplied a perennial stream, and was a great blessing in the locality; but recently Mr. Masholm, a native of the country who possessed some property near, in

deepening the well, discovered a conduit which poured a stream into it; and being the only water the well received or gave, showed that it was not the fountain-head; to discover which he caused the conduit to be opened along its length till arriving at two vaulted chambers, into which the water rose directly from the ground.

The roofs of these chambers are about eight feet below the surface of the land. And having got down through an excavation, we entered the first by an opening resembling a window in the side wall, some feet above the floor. The roof was formed of well-dressed astlar stone-work, and the side walls well built of equally solid material. From the floor, which consisted of the original naked rock *in situ*, a strong spring burst up in several places, clear as crystal, and cool from the bowels of the earth. An ordinary arched doorway opened from this chamber into the second, which in all respects resembled the first, save that it had no window-like aperture at the side. Each chamber, as well as I can recollect, was about ten feet square at bottom, and eight high; the floors were not quite level, which allowed of our standing on parts without getting wet, as the water flowed from the depressions into the conduit.

When examining Ain es-Suâni, where, as mentioned in Sec. 5 of this Chap., I think it probable a sealed fountain may also exist, I was partly led to that conclusion by having seen this concealed fountain, to which, if one exist at Ain es-Suâni, it must bear a resemblance.

As before observed, the long, tortuous aqueduct from the pools to Jerusalem was probably first constructed by Solomon, and no doubt it was made according to the best models of that age; but engineering science had not then attained to any great degree of advancement. During the disturbed state of the monarchy after his death, it was most likely neglected, and in course of time became dilapidated. Subsequently, towards the close of the thirteenth, or in the commencement of the fourteenth century, when Sultan Mohammed Ibn Kelaûn wished to convey water to the city, want of ability on his part, or of skilful engineers, might have obliged him to repair or reconstruct this inferior aqueduct, instead of a more modern one, on a far superior principle, of which there are even now remains, and which must have existed then also: as we have strong grounds for believing that it was built by Herod, and therefore anterior to his time. Substantial portions of it remain to the present hour, and,

there can be little doubt, existed also in Mohammed Ibn Kelaûn's time, in a more perfect state.

The distance between Solomon's Pools and the Haram esh-Sherif, in a direct line, being six miles and seven furlongs, whilst the present aqueduct is twelve and a quarter miles in length, it is manifest that if the water from the pools could be conveyed to the city by the shorter course, and thenceforward delivered without any trouble, by mere hydrostatic pressure, at a higher level than could be accomplished by the aqueduct of Solomon, that aqueduct, especially if considerably out of repair at the time, ought to have been abandoned.

As proved by the flow of water in Solomon's aqueduct, the pools are situate on a higher level than Jerusalem, and consequently nothing could prevent water being delivered from them into the city, on the hydrostatic pressure principle, but an intervening hill of greater elevation than themselves. No such obstruction happens to exist, and accordingly we find that at some period, probably, as observed, in the time of Herod, who could call to his aid the ability of Roman engineers, skilled beyond all others of the day in the science of hydrodynamics, the physical law was taken advantage of which compels water, when it cannot find

an outlet, to rise to the level of its source ; and a pipe of excellent workmanship was laid down from the pools to a distance of about three miles and a furlong, at which point the water, being delivered through the tube by hydrostatic pressure, flowed onward to the city, by the action of gravity, through a stone channel not tubular, but probably covered over, as the statement of Theochrites, given in Sec. 3 of this Chap., would lead to that conclusion.

A considerable portion of this noble work, which, for the sake of distinction, may be called the Aqueduct of Herod, is visible near Rachael's Tomb, between Mar Elyas and Bethlehem. As marked on the accompanying map, it lies a little to the east, and within sight of the public road between the two places, and is rather a conspicuous object. Other smaller and detached portions of it were discovered near Mar Elyas by Dr. Barclay, who accidentally came upon some Arabs in the act of digging up the stone of which it was formed for building material, in the same barbarous manner as the antiquities of the country have been *quarried* and carried off, age after age. He also discovered other remains of it still nearer to the city, on the plain of Rephaim, not far from the Hill of Evil Council ; and he told me that he observed one of the

perforated cubical stones of the tubular portion built up in a wall within the city.

The tubular portion of this aqueduct, as before mentioned, ends at about three miles and one furlong from the pools; that is, at about two-thirds of a mile nearer to Jerusalem than Rachael's Tomb, at which point an embankment was formed, which still exists, to raise the aqueduct above the level of the highest ridge of land intervening between the pools and the city. The stone tubing having come to the foot of this embankment, or rather wall, turned upwards at a right angle, or somewhat approaching to it, and having ascended the end of it, terminated at the top.

To this point the water was manifestly delivered by hydrostatic pressure through the tube, and poured out into a channel which ran along the top of the wall; till at the highest point of land which it is necessary to surmount, about one-third of a mile further on, the embankment wall ends, and the channel comes upon the level of the ground, at the ruins of an ancient watering place; which was furnished with a large trough cut out of a solid stone, seven feet in length, six and a quarter in breadth, and five and one-third in height, the hollow in it being two and a half

deep. It was placed in the immediate course of the channel, so that the water flowed through.

From this point we lose all trace of the aqueduct for about one-third of a mile further, where again it appears, and continues in a perfect state for about an equal distance, one-third of a mile : again it disappears for about one-fourth of a mile, and again re-appears for another one-fourth of a mile ; but thence to the city, a distance of about two miles and a quarter to the Jaffa Gate, it is only to be found in detached broken fragments.

To return to the first portion of the aqueduct, that composed of tubing, as distinguished from the second, or channelled portion. As above stated, it terminates about two-thirds of a mile north of Rachael's Tomb, and one-third of a mile south of the watering place, upon the highest ridge of land. It is composed of squared blocks of stone, perforated by a hole about nine inches in diameter, widened at one end to about fourteen inches, to receive a conical projection from the stone next it ; through which projection, as well as through the body of the stone, the hole passes.

The blocks being thus regularly formed with "*shoulder*," "*neck*," and "*socket*," are "*jointed*" with what we term "Roman cement ;" which perhaps

favours the opinion that the work was constructed by Herod. So firmly are the stones united, that in general they cannot be separated without breaking off the neck or conical projection of one, which adheres within the socket or enlargement of the aperture in the next.

For rather more than one mile and a furlong this stone tube can without interruption be traced above ground, terminating at the end of the embankment wall above spoken of; but between the overgrown portion and the pools, a distance of somewhat more than two miles, it is not visible. But, notwithstanding, in all probability, it continues in a perfect state; for at two or three points it has been discovered by Dr. Barclay beneath the ground, covered to a considerable depth with the *debris* of the overtopping hills.

It may have been so in Sultan Mohammed Ibn Kelaûn's time; and I verily believe that its existence was, on account of that selfsame circumstance, unknown to him: otherwise, I cannot account in any way for his not having chosen to repair this excellent aqueduct, instead of the very inferior one of Solomon. He doubtless must have been aware of the above-ground portion of it near Rachael's Tomb; but being probably very ignorant of the laws of hydrostatics, he

might have only marvelled by what means water had been ever elevated to the top of the embankment, higher than any part of the aqueduct which was visible to him : and not knowing how to accomplish the conveyance of it there again, abandoned his hope of doing so ; perhaps doubting what the object of the tube had been, or that it had ever effected its intended purpose.

SECTION 12.

BIRKET ES-SERAIN—BIRKET ISRAIL—POOL OF BETHESDA, AND SUPPOSED AQUEDUCT OF PILATE.

Birket es-Serain, the traditional Pool of Bethesda, lies within the city, adjoining the Haram on the north. *It is now dry* ; but being, according to Dr. Robinson, 360 feet long, 130 feet broad, and 75 feet deep (exclusive, he says, of the accumulated rubbish), its capacity is equal to 3,510,000 cubic feet, or 21,874,742 gallons. I have no doubt that this cistern was furnished with a tunnelled aqueduct, which conveyed water into it from a distant point—probably from Neby Samwil, to the north or north-west of the city (my grounds for believing so are given in the sequel). It was evidently constructed to serve a double purpose—a trench for the defence of the

adjoining fortress of Antonia, and a reservoir for water; but chiefly with the latter object in view, as it was unnecessarily wide for a mere trench, and several times the width of that which defended other portions of the fortress, quite as accessible. With so great a capacity, it could scarcely have been filled by any other means than that of an aqueduct, for the rain-fall within the city would not, I think, have been sufficient for the purpose, after having supplied the private tanks and the numerous other cisterns.

The two arched passages run from the western extremity of the pool, in a direction parallel to the Haram wall; the southern arch is 12 feet in width, and the northern one 19 feet. It is not reasonable to suppose that these could have been conduits, as Dr. Robinson and others imagine. A pipe 9 inches in diameter would have been of more suitable dimensions for that purpose; for, as shown in Chap. V., Sec. 5, with a fall of 1 in 480, or 11 feet per mile, it would convey $49\frac{4}{5}$ cubic feet of water per minute, equal to 25,964,640 cubit feet per annum; sufficient to fill the pool nearly $7\frac{4}{5}$ times. Therefore that idea should be altogether exploded; for these galleries would suffice to fill the pool or empty it in a few moments.

I consider that they were intended as "lodgments," similar to those described in Sec. 5 of this Chap., as pertaining to the Fountain of the Bath of Healing in Jerusalem; to the wells which supply the Trafalgar Square Fountains in London, &c.; that they were constructed to increase the capacity of the pool, and arched over to afford building space on top; as probably the body of the pool itself had been at one time covered, as it ought to be now; as the cistern of the "Thousand and One Columns" at Constantinople, referred to in Chap. V., Sec. 5, which is much larger, actually is; and also as some very capacious cisterns in Jerusalem are. (See descriptions of the Mekhemeh Pool, and Helena's Cistern, Secs. 13 and 17 of this Chap.)

Josephus mentions that Pilate offended the Jews by expending the sacred treasures, called Corban, upon aqueducts, by which he conveyed water into the city from a distance of 400 furlongs.* Making allowance for an evident mistake in figures, there is nothing improbable in the statement as to the formation of these aqueducts; and in all probability

* Jewish Wars—Book II., Chap. ix. 4. Trail's Josephus. Ed. by Mr. Isaac Taylor.

they will yet be discovered. The existence of this huge reservoir, that appears calculated rather to receive water from an external source than the mere rain-fall from within, and *which*, I repeat, *apparently could not have been filled by any other means*, together with the numerous other reservoirs, &c., within the city, is, to my mind, strong corroborative evidence in support of Josephus.

That *four hundred* furlongs is a mere error of transcription, the very magnitude of the number demonstrates. It is too great to be set down as even a boastful exaggeration, for the coast line of the country itself, and the Mediterranean Sea on the west, are less than 300 furlongs distant, and the high ground does not extend towards them much beyond one-third of the way. Hebron, south of which there is no elevated land from whence water could be derived, is not 160 furlongs off. The Mountains of Moab, on the east, are divided from Judea by the Dead Sea and the River Jordan, the valley of which, near the Dead Sea, being, according to Mr. Beardmore, 1,367 feet below the level of the Mediterranean, and not less than 4,116 feet lower than Jerusalem, no aqueduct could be constructed across it; either to convey water on the

level, for no piers could be erected of sufficient height, or accommodated to the surface of the ground, for in that case pipes should be introduced, and it would be impossible to construct any of sufficient strength to withstand a hydrostatic pressure of thousands of feet. And in a northerly direction—except Neby Samwil, about 40 furlongs off, and Mounts Ebal and Gerizim, nearly 250 furlongs off—there is no land of a higher elevation than Jerusalem till we reached Safed, about 725 furlongs distant, taking the elevations of the country as set down upon the figured sections of M. Van de Velde. Therefore “400” must be considered a clerical error—an oversight in copying the number.

Josephus, in *Jewish Antiquities*—Book XVIII., Chap. iii. 2—states that Pilate contemplated bringing water into Jerusalem from a distance of 200 furlongs. The discrepancy between this and the statement in his *Jewish Wars* may be partially explained (if explanation be attempted where an error has been proved, and ought to be admitted) on the supposition that possibly in the former he referred to the distance across the country in a direct line; whilst in the latter he might have spoken loosely of the length to which he believed the aqueduct extended in all its windings.

But the same physical features of the country which render it impossible to obtain a supply of water from 400 furlongs off alike render it impossible from a distance of 200. The facts above set forward will establish one case as strongly as the other.

My opinion is, that one of Pilate's aqueducts conveyed water to the Pool of Bethesda, and most probably received its supply from Neby Samwil. If not from that hill, it must of *necessity* have been either from Mounts Ebal and Gerizim, about 210 furlongs further north; from Hebron, about 160 furlongs south of Jerusalem; from the district around it; from the neighbourhood of Solomon's Pools, 55 furlongs S.W. of Jerusalem; from the Frank Mountain, about 60 furlongs S.E. of Jerusalem, the very summit of which only is higher than the city, and it could therefore furnish but a small quantity of water; or, lastly, from the Mount of Olives, and the range of hills immediately bordering on the city. In none of these cases can the measurement of either 400 or 200 furlongs be established; unless we resort to the supposition, which, without laying much stress upon, I venture to advance, that Pilate adopted a method for supplying the city with water similar to that which I have proposed, which will be found discussed at some length in

Chap. V., Sec. 2; and that the *united* lengths of *all* his aqueducts, main channels, and perhaps minor ones also, measured in direct lines from the commencement to the termination of each, made up 200 furlongs; or, including their windings and circuitous courses, 400 furlongs: upon which assumption, the word "distance," as used by Josephus, cannot have been applied in its strict meaning.

There is no direct testimony to prove that Pilate might not have been the constructor of either of the aqueducts from the Pools of Solomon to Jerusalem, mentioned in Chap. II., Sec 11, but it is most probable, as therein stated, that one of them should be properly ascribed to Solomon, and the other to Herod.

SECTION 13.

BIRKET EL-OBRAṬ — MEKHEMEH POOL — COVERED RESERVOIR IN MILL VALLEY.

In the Mill Valley, at the principal entrance of the Haram, called the Gate of the Chain, immediately north of the Jews' Wailing Place, is a large covered reservoir, 84 feet long, 42 broad, and 24 deep, having, therefore, a cubical capacity of 84,672 feet, or 527,685 gallons. It adjoins the wall of the Haram, and

Temple Street, as the continuation of David Street from the centre of the Tyropœon to the Gate of the Chain is called, passes over it. The Mekhemeh, or City Council Chamber, is also built over part of it. Its eastern side is a continuation of the wall at the Jew's Wailing Place, and built of the same description of massive stones, supposed to have been part of the structure of the ancient Jewish Temple. The aqueduct ascribed to Solomon, from the pools beyond Bethlehem (see Chap. II., Sec. 11), passes either through or close to it.

Schwarz mentions that this reservoir was first discovered by the Moslems in 1845. Tobler is the first who gives any account of it (Denkbl., p. 41, sq.), and Dr. Barclay, who explored it in 1852, describes it very particularly. There is also a cistern of considerable size between it and the Bath of Healing, close to the latter.

SECTION 14.

BIRKET HAMMAM SITTE MYRIAM.

Birket Hammam Sitte Myriam is a deep reservoir, immediately outside St. Stephen's, or the eastern gate of the city; it is about 96 feet long, by 50

broad, and, speaking from memory, I should say about 20 feet deep ; therefore it has a probable capacity of 132,480 cubic feet. It usually contains some stagnant water during nine months in the year.

SECTION 15.

RESERVOIRS OUTSIDE DAMASCUS GATE.

Close to the Damascus Gate, outside, and north of it, near the mouth of the subterranean quarry beneath the city, described in the note to Chap. I., Sec. 1, is a capacious reservoir, but in a dilapidated condition. It was originally sunk in the solid rock, and two of its sides have been completely removed in the process of quarrying stone, and thereby a chasm has been made between it and the Damascus Gate, which is on a lower level than the surface of the ground thereabout. In its original state it might have contained about 50,000 cubic feet of water. It is shown in the wood-cut, taken from a photograph, in Chap. I., Sec. 1. I shall speak of it hereafter, in connexion with the flushing of the city sewers, in Chap. V., Sec. 5, and Chap. VI., Sec. 3. South of this, and also near the Damascus Gate, is another ancient reservoir in a still more dilapidated condition, which I shall not again refer to.

SECTION 16.

BIRKET EL-HEJJEH.

Another similarly situated but smaller reservoir, called Birket el-Hejjeh, lies between Herod's Gate, at the same side of the city, and the N.E. angle of the wall. It is about 40 feet square, as measured from Dr. Pierotti's large Map, first edition; and allowing it to be 20 feet deep, its capacity is 32,000 cubic feet.

SECTION 17.

HELENA'S CISTERN, NEAR THE CHURCH OF THE HOLY SEPULCHRE.

This cistern is situate on the east of the Church of the Holy Sepulchre, near the traditional Rock of Golgotha, in the Convent of the Copts. It is said to possess an inexhaustible supply of water; but this has never been proved. If it be true, it cannot arise from a natural spring; for, as shown in Chap. IV., Sec. 1, and Chap. V., Sec. 1, it is, in the nature of things, a physical impossibility that a perennial spring could exist in such a situation as the top of the rocky eminence upon which Jerusalem stands; and I

can only surmise that one of Pilate's aqueducts, spoken of in Sec. 12 of this Chap., may terminate in this cistern, and even now supply it with water.

The same observation applies to the well in the Church of the Flagellation, in the Via Dolorosa; and generally to all other receptacles for water within the city, respecting which statements are current, or from time to time set forth, of unfailing supplies. They may possibly receive contributions from some conduit as yet undiscovered. I did not visit Helena's Cistern, but the following description of it was written for my information by the Rev. W. D. Veitch, late Chaplain to the Bishop of Jerusalem: "It is reached through some ruinous houses, at the east end of the Holy Sepulchre, through a piece of ruin which, if I mistake not, is called 'Helena's Treasury.' How far it goes underground I do not know. It would need a boat to explore it; but with a strong reflector and a bull's-eye lantern I could faintly discover the extremity of the cave, and made out, as I fancied, the opening of an arched passage to some other place."

According to Dr. Barclay, it is about 60 feet long, and 30 wide. Professor Porter says: "It is of great extent, and excavated wholly in the

solid rock. We descended by a long flight of steps, also cut in the rock, with a massive balustrade."

SECTION 18.

OTHER RESERVOIRS AND CISTERNS.

There are many other reservoirs and cisterns, both within and without the city, of sufficient magnitude to claim attention, but chiefly the property either of institutions or private individuals. Those I have described are the most important, and the greater number of them public property.

SECTION 19.

AQUEDUCT OF THE MAMELUKE SULTAN KAITUBAI— REPUTED UNDER-GROUND STREAM NEAR THE DAMASCUS GATE—REMAINS OF AQUEDUCT NORTH-WEST OF CITY.

We possess a most important historical account, alluded to by Tobler, that in the 15th century, Kaitubai, one of the Mameluke Sultans of Egypt, constructed a channel or tunnel through the mountains, whereby he conveyed water to Jerusalem, from the desert hills beyond Hebron; that the work occupied thirty-seven years; during which time six hun-

dred men were constantly employed in the operations. He likewise mentions, that in the year 1336, a European traveller observed and described an aqueduct that conveyed water to Jerusalem from the vicinity of Hebron ; which, if true, proves that even before the time of Sultan Kaitubai a water-course existed from Hebron to the city.

There is at present a report current among the Arabs at Jerusalem, that on a calm night, when all around is still, the sound of running water, as if through an aqueduct, may be heard by placing the ear to the ground, at a particular point, close outside the Damascus Gate. Respecting which, Mr. Thrupp, with shrewd observation, in upholding his argument, that the present north wall of the city does not occupy the site of any one of the ancient walls, observes :—

“ Another curious circumstance may be mentioned as illustrating the correctness of the conclusion at which we have arrived respecting this wall. While the modern native report declares that at a spot near the Damascus Gate, outside the city, there may be heard the trickling or murmur of a subterranean watercourse, the narrative of Aristeas* informs us that

* Given in Sec. 3 of this Chap.

the same sound was to be heard more than four stadia outside the city of his day. If we may assume the spot indicated in this narrative to be the same as that to which the modern report refers, it is evident that there could not in the time of Aristéas, or the author of the letter ascribed to him, have been a gate—either standing, or in ruins—on the site of the present Bâb el-Amûd. But if the correctness of the shorter course that we have marked out for the second wall be admitted, it will be found that the distance from the nearest gate to the spot where the trickling is now to be heard may be well reckoned at about four stadia.”

As I have already mentioned in Sec. 6 of this Chap., these aqueducts may possibly have a connexion with the Fountain of the Virgin, and perhaps contribute to its intermittent flow.

Gaddow (zs. d. D. morgeul. Ges. III., p. 41) mentions the existence of a ruined aqueduct at the N.W. angle of the present city. This must be identical with the aqueduct (by whomsoever made), of which the ruins of a small portion still remain, and are marked on the Map, 680 yards N.W. from the Damascus Gate.

CHAPTER III.

SECTION 1.

KING HEZEKIAH'S WORKS.

When we read in the Scriptures of King Hezekiah taking counsel "to stop the waters of the fountains which were without the city," and of his having "stopped all the fountains and the brooks that ran through the midst of the land" (2 Chronicles xxxii. 3, 4.), it may simply mean that he broke in the roofs, and stopped up the various *reservoirs* existing on the upland outside the city, and in the valleys around—reservoirs and cisterns throughout Judea, where true springs are of rare occurrence, being in common *parlance* termed springs or fountains. *Moy* is the present Arabic, and applied indiscriminately to cistern, tank, reservoir, well, spring, fountain, though the literal meaning is a fountain.* The ruins

* *Ain* is confined in its strict meaning to a spring of living water.

of many of these, some of them possibly those destroyed by Hezekiah, I myself have seen.

“Brooks which ran through the midst of the land,” apparently means the aqueducts or channels through which the water “ran” from these reservoirs into the city, or by which it was conveyed from the cisterns, &c., “through the midst of the land,” for irrigation and other purposes.

If a true spring, of sufficient magnitude to support a running brook, existed in an upland country, “stopping up” would not for a moment check the flowing of the stream; the water would still continue to burst forth, either at the same or some adjacent point.

The Scripture also informs us that Hezekiah “stopped the upper water-course of Gihon, and brought it straight down to the west side of the city of David” (2 Chronicles xxxii. 30). Also that “he made a pool and a conduit, and brought water into the city” (2 Kings xx. 20). Also, in Ecclesiasticus xlviii. 17, we find, “Ezekias fortified the city, and brought in water into the midst thereof; he digged the hard rock with iron, and made wells for water.”

Whether the name Gihon has been properly or improperly attached to the pools in the Valley of

Hinnom, at the west of the city, and whether the names Zion and city of David have correctly or not been associated with the south-western hill on which Jerusalem stands, are questions which admit of controversy. Nor is it my object to discuss them here. It is enough for the present purpose to state that, for reasons given in the Appendix, No. 4, it is *possible* these names may have been misplaced; *if* that be so, "the upper water-course of Gihon," might have referred to the outflow from a spring in the Valley of Jehoshaphat, N.E. of the city; and the "city of David," synonymous with "Mount Zion," might be the south-eastern hill, usually called "Mount Moriah," and known as that upon which the Temple stood; but as it is not necessary for the object of this work to advocate these opinions very strongly, I think it sufficient to set forth the arguments in favour of them in the Appendix; and in this place merely wish to state that the thing is not only *possible*, but not very improbable.

Premising, then, that it is *possible*, I have found strong indications of a copious spring at the place called Ain es-Suâni, before referred to (Chap. I., Sec. 4, and Chap. II., Sec. 5). The word *Ain*, of which the name is compounded, would in itself suggest the idea

that formerly water, in some form or other, was to be had there. The passage in Ecclesiasticus referring to the works of Hezekiah, "he digged the hard rock with iron;" or, as the writer of the Books of Maccabees, in reference to the same transaction, expresses it, "he dug with iron into the rock" (1 Maccabees xlviii. 17), taken with the context, cannot more intelligibly mean anything than that he *tunnelled*, "dug with iron into [through] the rock;" and it may be seen, by an inspection of the rock-hewn aqueduct from the Well of the Virgin to the Pool of Siloam, that the Jews were not unacquainted with the art of tunnelling, though performed in a rough and unskilful manner.

The bottom of the well at the Fountain of the Bath of Healing, being far below the level of the Tyropœon, is lower than the land at Ain es-Suâni. The words "he brought water into the *midst* thereof," accurately speaking, cannot be supposed to mean bringing water merely to the Pool of Hezekiah, which at that time was not in the *midst* of the city, but at its extreme verge.

The concluding words of the quotation, "and made wells for water," after he had "brought *in* water," as it would appear by tunnelled aqueducts, evidently mean that he formed cisterns to receive it. One of

these may be the Fountain of the Bath of Healing, with its capacious gallery, or "lodgment;" another may be the Pool of Hezekiah, to which a partly-covered passage is ascertained to exist, from the Upper Pool of Gihon, as mentioned in Chap. II., Sec. 9; a third, the greatest of all, may be the Pool of Bethesda, which I have no doubt, for the reason mentioned in Chap. II., Sec. 12—to my mind conclusive—was supplied by a tunnel from a distant locality; originally, perhaps, by Hezekiah, and subsequently, as mentioned in the last Section referred to, by Pilate; who may have either reconstructed the old aqueduct of Hezekiah, or aided it by a new one from a distant locality, to obtain a greater quantity of water. An exploration in search of these would be attended with exceedingly great interest.

The small aqueduct lately discovered in excavating for the foundation of the Prussian Hospice may likewise have been a portion of one of the aqueducts either of Hezekiah or Pilate.

For these and other reasons connected with the nature of the locality, I am strongly impressed with the opinion that there may exist at Ain es-Suâni a well, covered over, "*sealed*," and hidden; and that from it, a deep-seated aqueduct, possibly the work

of Hezekiah, may at this moment convey water to a reservoir within the city, the Fountain of the Bath, of which I have spoken. The determination of this point would also be a task of peculiar interest.

SECTION 2.

QUALITY OF THE PRESENT WATER.

Rain-water received directly from impervious surfaces, such as roofs of houses and paved yards, is practically free from all admixture of earthy or organic salts, or other foreign matter, except gases, which, in small quantities, it absorbs from the atmosphere, while it floats in the state of vapour, or after condensation during its descent in the form of rain.

Rain-water collected quickly from a drainage area of ordinary land, before it has had time to penetrate deep into the earth, is also comparatively pure, not having come in contact with mineral ingredients to any great extent; and the organic matter met with, unless in a highly-manured agricultural district, is likewise inconsiderable.

On the quality of river-water there is no occasion for remark, there being no river in the neighbourhood of Jerusalem from which water might be procured.

Water derived from springs and deep wells is generally highly charged with foreign matter—gases of various kinds; earthy salts; alkaline bicarbonates of soda and potash; occasionally oxyde of iron; and sometimes, as is the case at Jerusalem, with organic salts; decomposed animal and vegetable substances, and other impurities, with which it comes in contact in percolating through the surface soil, before reaching the subjacent rock.

Though rain-water directly received into cisterns, or quickly collected from a drainage area, is not agreeable to the taste of persons unaccustomed to it, it is wholesome; and, being free from bicarbonate of lime, &c., which imparts the quality called "*hardness*" to spring-water and that obtained from deep wells, it is better adapted for culinary and cleansing purposes.

The pungent, agreeable taste, imparted to good spring-water by the presence of carbonic acid, and a slight admixture of saline ingredients, is, in the case of the wells at Jerusalem, entirely neutralised at present, and the water rendered more than offensive and unwholesome, by the excessive quantity of refuse liquid matter contained in it; and for this there is no remedy till an efficient system of sewers, such as that

recommended in Chap. VI., Sec. 2, shall have been supplied for the relief of the citizens.

It is obvious, also, that in summer the relative impurity of the water increases in proportion as the quantity diminishes. How manifestly detrimental to health, comfort, trade, and all advancement in civilization is this deplorable state of things with respect to an essential element of life ; and how simple is the remedy !

The following tables by Dr. Barclay show the specific gravities and relative impurities of the several waters, so far as solid or insoluble matter is concerned, but give no analysis by which the amount of saline and soluble ingredients might be determined :—

SPECIFIC GRAVITY OF THE WATERS OF JERUSALEM AND
ENVIRONS, THE JORDAN, AND DEAD SEA,

Distilled water being 1,000.

Cistern Water from the [American] Mission Premises	1,002 $\frac{1}{2}$
From Inner Well of Flagellation Church . . .	1,002
From Ain Hammam esh-Shefa	1,004 $\frac{1}{2}$
From Virgin's Fount	1,003 $\frac{1}{2}$
From En Rogel	1,002 $\frac{1}{2}$
From Jordan	1,001
From the Dead Sea*	1,128

* I brought home some water from the Jordan, and also from the Dead Sea. The former was at first very muddy, and of a whitish hue ; but, after a while, the gross particles became floccu-

RESIDUUM YIELDED BY EVAPORATION FROM EBULLITION.

128 oz. of water from	Ain Hammam esh-Shefa .	185 grains.
128 " "	Virgin's Fount . .	93 "
128 " "	Flagellation Well . .	32 "
128 " "	Mission Cistern . .	16 "

It would appear from the foregoing experiments, that, according to the table of densities, the purity of the waters of Jerusalem ranks in the following

lent, of a darker colour, and subsided, leaving the water, as now it is, clear. That from the Dead Sea (like the Sea of Galilee, which Byron, in his beautiful poem on the Destruction of Sennacherib, incorrectly alludes to as having a "*blue wave*," if he mean the intrinsic hue of the water, and not the colour reflected in the wave from overhead) is perfectly colourless, and free from the slightest tinge of green, such as in ordinary sea water; it possesses an extreme degree of transparency and brilliancy almost equal to diamond. In bathing in it I found the salt very painful to the eyes; not at the time of immersion, though I opened my eyes under the water, but in a few moments afterwards, when the sun, by causing evaporation, had left a residuum of salt. Its high specific gravity renders it difficult to swim in it, there being a constant tendency to raise the feet towards the surface, so that in striking backwards they are apt to kick over the water.

It has been almost proved to a certainty, in a paper presented by the Earl of Clarendon to the Royal Geographical Society of London in 1856, that animal life is sustained in the Dead Sea, which was formerly supposed to be without fishes or life of any description. The paper communicated by Lord Clarendon was transmitted to him from Syria by Mr. Poole, who is again mentioned in Chap. V., Sec. 5, and

order: 1st, Well of Flagellation Church; 2nd, En Rogel; 3rd, Cistern; 4th, Virgin's Fount; 5th, Ain Hammam esh-Shefa.

But, according to the trial by ebullition, the order is somewhat different, as follows: 1st, Cistern Water; 2nd, Flagellation Well; 3rd, Virgin's Fount; 4th, Ain Hammam esh-Shefa. (En Rogel not tested).

states that on three or four occasions he saw ducks flying over the Dead Sea, and also lighting upon the water, and frequently diving. From which he inferred that they were engaged in catching their prey, either fishes or marine insects, or feeding upon plants. Unfortunately they were so wild he could not approach near enough to shoot any, that he might examine the contents of their stomachs, whereby the question would have been completely solved.

He saw many small fishes in streams that ran into the Dead Sea. I also saw small fishes, about two inches long, in great numbers in the stream near Jericho, supposed to be "the brook Cherith, that is before Jordan" (1 Kings xvii. 3), where Elijah was miraculously fed by the ravens. This stream flows into the Jordan, and by that means communicates with the Dead Sea. I also saw quail, and a large species of plover, common in Egypt, close to the Dead Sea. The herbage there is scanty, and the soil, to some extent, incrustated with salt. On the banks of the Jordan the trees are luxuriant, and early in the morning I heard nightingales singing in them.

SECTION 3.

SOURCES, EXTERNAL AND INTERNAL, FROM WHICH AN INCREASED SUPPLY OF WATER MIGHT BE PROCURED.

The primary source of all water given to man is the moisture of the atmosphere descending either in the congealed forms of hail and snow, or in the liquid states of rain and dew. Snow and hail falling on the earth become liquefied by warmth ; and by a reduction of temperature, as the chief agency, uncongealed moisture suspended in the air is precipitated as rain or dew : rain being that source from which the greater quantity of water is derived.

The expressive words of Pliny upon this subject are concise : "The river springs from the earth, but its origin is in heaven," which may be with equal truth applied to all fountains and brooks.

The water having fallen from the heavens, may be rendered available for the service of a city in various ways.

Firstly—It may be intercepted either before it can reach the ground, or, having reached the ground, before it can penetrate into it ; and be conveyed

directly from the roofs of houses, paved yards, or some impervious surface, into tanks and vessels.

Secondly—It may be conducted into reservoirs from the surface soil of a district, by the construction of covered drains or open channels, to collect the moisture, and cut off its flow from the natural water-courses of the country.

Thirdly—It may be obtained from these natural water-courses themselves—that is, from streams and rivers.

Fourthly—It may be derived from natural springs, termed "*surface*" springs, or shallow wells, as distinguished from deep wells.

Fifthly—From deep wells, which, not inaptly, may be termed artificial springs.

Of these methods of supply only the first, second, fourth, and fifth can be made available at Jerusalem, as there are neither rivers or streams in the locality. In Chap. IV., Sec. 5, and Chap. V., Secs. 1 and 2, I shall more fully discuss the capabilities of each separately, with a view of ascertaining what total amount of water might be supplied to the city under proper arrangements, and what the increase would be above the present quantity; but, at present, I merely wish to have it borne in mind, that these four are the only

sources from which an increased supply can be expected.

A portion only of the total rain-fall is capable of being collected into reservoirs. The mode best adapted for collecting the rain-fall in Syria, on a large scale, is by the formation of embankments across valleys, after the fashion of Solomon's Pools, described in Chap. II., Sec. 11 ; or of the Serpentine in London ; but, in addition, means should be adopted, by a system of surface drains, to draw the largest amount possible into the reservoirs.

The forming of an artificial impervious surface over a large extent of country, to prevent any loss of water by absorption into the ground, would be too expensive a process for general adoption, till the resources of the country shall have been further developed. The cost would be at least 1s. per square yard, or £242 per acre, exclusive of the purchase of the land, which expense could not be now incurred, though it would yield a high interest if purchasers for the water, or ratepayers, could be found, as in European towns.

The average depth of rain-fall at Jerusalem is 65 inches in the year, as shown in Chap. IV., Sec. 5 ; therefore, the quantity of water which could be ob-

tained from one acre would be 235,950 cubic feet, or 1,470,464 gallons per annum; making no allowance for loss, even by evaporation, which would be inconsiderable, as the water would run off quickly from the smooth surface into tanks. At 6d. per thousand gallons this quantity would realise £36 15s., being a profit upon each acre of £24 13s., after paying interest at 5 per cent. on the outlay in preparing the impervious surface.

From this should be deducted the interest of the money expended in the purchase of the land, and a proportionate part of the expense of constructing the reservoir, and of laying the service pipes into the several houses, if such should be done.

Though 6d. per thousand gallons may appear a high price, it is obtained in many European towns for procuring and distributing water. In Jerusalem, on account of the abundance of the rain-fall, water might be procured and distributed at a very low comparative outlay—especially if, instead of aspiring to collect *all* the water which falls upon a given space by constructing an artificial surface, the ordinary flow from the soil only should be intercepted, by means of drains, in which case the disadvantage of a smaller quantity of water received from a given surface would

be more than counterbalanced by the power of bringing into action, by a given outlay, a greater expanse of country; the expense of the purchase of land, and of forming an artificial surface, being avoided, and, instead thereof, only the small cost of forming drains necessary.

The collecting of water from a surface rendered impervious by artificial means need not be had recourse to, for I shall presently show, in Chap. V., Sec. 2, and the preceding pages, that, even though the population of Jerusalem should increase (as I am perfectly assured in my own mind it shall do) to many times its present numbers, without any extraordinary effort or expense, the district is capable of yielding five gallons a-day of pure water to each individual in a population of upwards of 3,200,000—about 400,000 more than that of London.

It is by the application of a suitable arrangement of drains that surface water should, on a large scale, be collected. I have shown in Chap. I., Sec 4, that within the city walls, exclusive of streets and unoccupied ground, there is an extent of 796,921 square yards of impervious catchment surface, in roofs of buildings and yards, from which 38,872,762 cubic feet, or 242,259,719 gallons of pure water might be annually

obtained, without any cost beyond that of constructing covered reservoirs (sufficiently capacious to receive and prevent it deteriorating in quality, and from being diminished by evaporation), which would, if fully taken advantage of, materially reduce the expense of the entire requisite supply.

In collecting water from the catchment basins, care should be taken to conduct it as quickly as possible into the receptacles prepared for it; for, if long exposed on an extended surface, the loss by evaporation would be great, especially in a warm climate.

The following result of an experiment, with regard to evaporation in England, may give some idea of the rate at which it operates in a much warmer country and more elevated region. At Highfield House Observatory, near Nottingham, the evaporation from a given surface, kept constantly moist and exposed to the air, in the year 1854 was found to equal 41 inches in depth of water, or about two-thirds the average yearly depth of rain which falls at Jerusalem, and more than twice the annual depth which falls at Nottingham itself, which in the year mentioned was only about $17\frac{1}{3}$ inches; showing that by this powerful agency, if not protected from it, more moisture would be carried off in a year than the amount which or-

dinary rains could supply : which proves the necessity for collecting the rain-water quickly, and reducing the surface exposed to the air, by placing it in cisterns—the narrower and deeper in form, the more efficacious—and when practicable, it is of importance that they should be covered.

Mr. Beardmore says : “ In the temperate zone, with a mean temperature of $52\frac{1}{4}$ degrees, the annual evaporation has been found to be between 36 and 37 inches. At Cumaná, on the coast of South America, (N. lat. $10\frac{1}{2}$), with a mean temperature of $81\cdot86$ [nearly 82] degrees, it was ascertained to be more than 100 inches in the course of the year ; at Guadaloupe, in the West Indies, it has been observed to amount to 97 inches.” According to his tables, the mean temperature of Jerusalem is $62\cdot6$, a little more than $62\frac{1}{2}$ degrees.

It is shown in Chap. IV., Sec. 5, that the total annual depth of rain at Jerusalem is 65 inches. It appears from Chap. V., Sec. 1, that, in that locality, 10 per cent. of this, or $6\frac{1}{2}$ inches in depth, is an approximation to the quantity absorbed for the supply of springs, &c.

To assist the reader in judging for himself in this matter, and to form his own opinion, if he

should not agree with mine—first premising that the greater porosity of the soil at Jerusalem than in Hertfordshire, and the greater depth of rain-fall, must be taken into account, with other circumstantial differences—I quote the following from the laborious compilation of Mr. Beardmore. Speaking of experiments which extended over a series of eight years (from 1836 to 1843), made by Mr. Evans, at Apsley Mill, King's Langley, Hertfordshire—during which time the mean annual rain-fall was 26·61 inches in depth, and the mean filtration 11·29 inches, or 42·4 per cent. of the rain-fall; the mean rain-fall for the six months from October to March, 13·95 inches, and the mean filtration, 10·39 inches, or 74·5 per cent.; and the mean rain-fall from April to September, 12·67 inches, and the mean filtration 0·9 inches, or 7·1 per cent.—he says: “Now the average filtration from April to September, of the above eight years, may be taken as nothing, for all practical purposes; while, from October to March, we have an average of 10·39 inches filtered through, out of the 13·95 inches total fall. Of this winter portion of 10·39, we must allow at least six inches for floods running away at the time of rain, and then we have only 4·39 inches left for the supply of rivers and wells, which, assuming our esti-

mate of 4 inches for that due to rivers, leaves only .39 of an inch for wells alone. It is certain that this small quantity would give all that we have as yet known of the draft of wells in all ordinary cases ; for, how notorious it is that ordinary wells fail in summer time, and how few wells there are of a never-failing character, unless they have some substantial reason for that quality."

Of the remaining 90 per cent., we may, perhaps without any material risk of error, assume that one-half—that is, 45 per cent. of the entire—or $29\frac{1}{4}$ inches in depth, is carried off by evaporation, and absorption by animal and vegetable life, by the process called *endosmos* ; and that the other one-half, or $29\frac{1}{4}$ inches, flows off upon the surface, or at a depth not exceeding three feet below it, to supply the tanks and reservoirs in the neighbourhood, or escape by the Valleys of Jehoshaphat and Hinnom.

The ordinary *rough* rule in England, for estimating the amount of water which might be collected from a district by a given means, is : "One-third of the total rain-fall flows off at the time of rain by streams and rivers ; one-third in part evaporates, and partly combines with animal and vegetable life ; the remaining one-third sinks into the earth to a depth

greater than three feet, for the permanent sustaining of springs, wells, and rivers."

But this being only the ordinary, or "rough" rule ; and in the locality in question, as the heat of the climate and the steepness of the ground admit of only one-tenth sinking deep into the earth, as shown by the analogies in Chap. V., Sec. 1; and as there is no apparent cause why the proportion between the other two cases should not hold good—I shall found the calculations upon the assumption that $29\frac{1}{4}$ inches in depth over the extent of the catchment basins is the amount of water which might be rendered available for the supply of Jerusalem by surface drainage.

From Beardmore's tables, it appears that the Thames, Severn, Loddon, Medway, and Nene, flowing through a great variety of soils, many of them possessed of but slight absorbent properties, carry away in the warm part of summer less than one-eighth of the daily average of the total annual rain-fall.

It also appears that upon the average of several rivers in Great Britain, from one-third to four-fifths of the total annual rain-fall flows off upon the surface, or by what may be called surface drainage—that is, *upon*

the surface, or at a depth below it not exceeding three feet ; which results, making allowance for steeper ground and a higher evaporation, counterbalanced to some extent by a more porous soil, agree closely with the assumption in the case, taken as somewhat analogous, of the district about Jerusalem.

CHAPTER IV.

SECTION I.

THEORY OF SPRINGS.

The theory of springs is simple: water falls from the atmosphere, either in a liquid or congealed state; such portion of it as does not flow off by surface drainage, is not evaporated by heat, enters not into combination with animal and vegetable life, by the process of endosmos, or becomes absorbed by the thirsty winds; sinks deep into the earth, and furnishes the ordinary source from which springs, and wells of every description, obtain their supplies.

In endeavouring to ascertain the amount of water which the wells of any given locality may yield, it is in the first place necessary to determine as nearly as possible what proportion of the rain-fall in that district sinks deep into the ground; for it is evident,

from what has been stated, that this is the utmost amount that can, under any circumstances, be recovered and brought again to the surface, either by the natural outflowing of springs, or from wells by manual labour or applied machinery; and in practice, even in the most exceptional cases, wells never produce the whole of this theoretical quantity. The quantity which sinks into the ground is regulated by various circumstances, such as temperature, the geological structure, and the physical outline of a district, &c. The more moisture withdrawn by evaporation, by combination with animal and vegetable substances, by rivers and water-courses, the less will remain to sink into the earth.

Other circumstances being alike, it is evident that in warm climates evaporation must take place more rapidly than in cold. A retentive clay soil and a system of impervious rocks will not permit so much water to subside into the earth as a gravelly soil overlying a deposit of porous rock; consequently, more is compelled to flow off upon the surface in streams and channels.

The contour of a country likewise affects the question materially. In a mountainous district the rain rapidly rushes down the steep slopes, and quickly

departs in streamlets, allowing little time for any to evaporate or subside into the earth. In a gently undulating country this effect is produced in a lesser degree ; and least of all, *cæteris paribus*, in a perfectly level district.

In the words of Beardmore : “ It remains to be discussed in what consists the condition of so-called never-failing supply to wells. They are of three classes :—

“ First—When the depth is small, so as to catch only the adjacent percolating water, which may be expected to travel from the surface within a short period of time. In this class may be placed ordinary domestic wells.

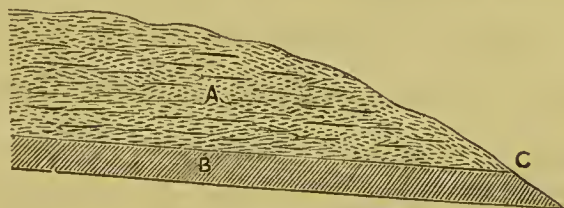
“ Second—When the depth is great, through, or into, pervious strata, which have a more remote derivation of water, and whose power of drawing such water towards them is created by the depth given to the well, and limited only by the friction of water through the strata. It is the element of friction, even in the most permeable strata, which gives a practical limitation to the supply of water to these wells.

“ Third—In the third class of wells may be taken those which are sunk into strata which form the

water-bed, or absolute reservoir, of water flowing from adjacent hills, and having impervious beds below, which uphold such subterranean streams."

Such springs as burst forth spontaneously from the surface of the ground, and such as may be reached by slight excavations, may be termed surface springs, as distinguished from those which must be sought by deep shafts or borings.

Surface springs are most commonly caused by the occurrence of an impervious bed beneath a pervious superstratum, which, becoming saturated with moisture, an "easement" takes place at the lowest or most favourable point along the outcrop of the impervious stratum. The accompanying diagram will illustrate this: Let A represent a body of porous



SECTION ILLUSTRATIVE OF THE PRINCIPLE OF SURFACE SPRINGS.

strata, superposed on the impervious stratum B; then at c, the lowest point upon the edge or outcropping of B, the spring issues forth.

There are other circumstances under which surface springs are developed, caused by geological faults, &c.; but being all mere complex varieties of the foregoing conditions, it is unnecessary, for the present purpose, to enumerate them.

I have already (Chap. II., Sec. 8) given a section and detailed particulars of En Rogel, an ordinary well, where water has been arrived at by means of a shaft 130 feet in depth.

Jacob's Well, in Samaria, is another ordinary well. It is sunk altogether through rock. The diameter is nine feet, and, according to Maundrell, it is 105 feet in depth.

These examples show the average depth of wells in the country, and that there is little chance of finding water till a depth of over 100 feet has been attained. And that neither of these wells is sufficiently deep is also manifest, as both frequently go dry towards the end of summer. When I visited Jacob's Well, in March, 1862, it contained water; but I was informed that from July to November it seldom does so.

Some statistics on the subject of well-water will not be uninteresting.

In numberless instances, the quantity of water

yielded by a deep well has been augmented by a boring being effected at the bottom of the shaft, to the requisite depth.

A well at Bootle, near Liverpool, 45 feet in depth, had sixteen holes bored at the bottom, some of them 600 feet deep ; previous to which it yielded but little water, but after the operation it produced 112,792 gallons per day. An experiment tried upon it by the late Mr. Stephenson, by stopping all the holes except one, proved that nearly the same amount of water would have resulted from the boring of one hole only as from the entire sixteen.

The Green Lane Well, at Liverpool, is 185 feet deep. In the year 1850, it yielded, according to the report of Mr. Stephenson, 991,118 gallons per day ; since which, a boring 98 feet deep has been sunk in the bottom of it, and it now yields 2,413,068 gallons per day, being more than double what it produced independent of the boring.

That called the Windsor Well, at Liverpool, is 210 feet in depth. In 1850, it yielded 678,560 gallons per day ; a hole, 214 feet deep, has been since bored in the bottom, which has increased the quantity to 1,020,493 gallons per day.

When the shaft of the well at Reid's Brewery, in

London, had been sunk to the depth of 202 feet, an experimental hole was made, to ascertain whether additional water might not be obtained at some greater depth; by which it was proved that such would be the case at a further depth of 20 feet; whereupon, the shaft was deepened 22 feet, with a diameter of 7 feet.

I therefore recommend that an augur hole should be sunk at the bottom of En Rogel, and if a considerable increase of water be met with, that the shaft should be deepened to the level from which it springs. The expense of boring is spoken of in Chap. IV., Sec. 2. It is highly probable that this well, if sunk deeper, would intercept the water from what may be appropriately termed, a *geological* drainage area, far more extensive than the mere surface drainage area pertaining to it; and thus yield, in addition to the quantity due to its own immediate district, a portion of the water which falls in more distant localities.

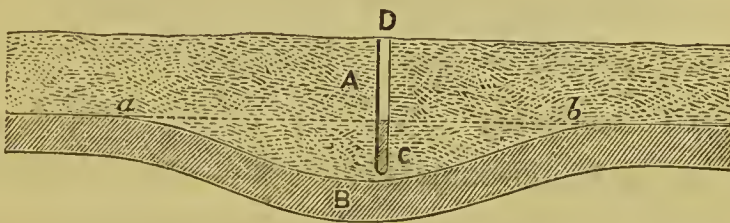
The well at Reid's Brewery yields 277,200 gallons a day, and is formed into a reservoir at the bottom, capable of containing 100,800 gallons.

Mr. Stephenson states that the Windsor Well, even before it had the bore made at the bottom, affected the wells in the neighbourhood for a distance

of one mile and three-quarters. He also reports that an abundance of water is stored up in the new red sand-stone, which may be obtained by sinking shafts and driving tunnels; that the sand-stone is generally very porous, admitting of deep wells drawing their supply from distances exceeding one mile.

Though the rocks in Judea are of a different formation, yet, being soft and cavernous, they are, I believe, capable of retaining about the same amount of water as the new red sand-stone; and a comparison instituted between them may be taken as at least an approximate guide in estimating the "*power*"—that is, the length of draft—of wells in the neighbourhood of Jerusalem.

The following diagram will illustrate the principle under which the most efficient of such wells are



SECTION ILLUSTRATIVE OF THE PRINCIPLE OF ORDINARY
DEEP WELLS.

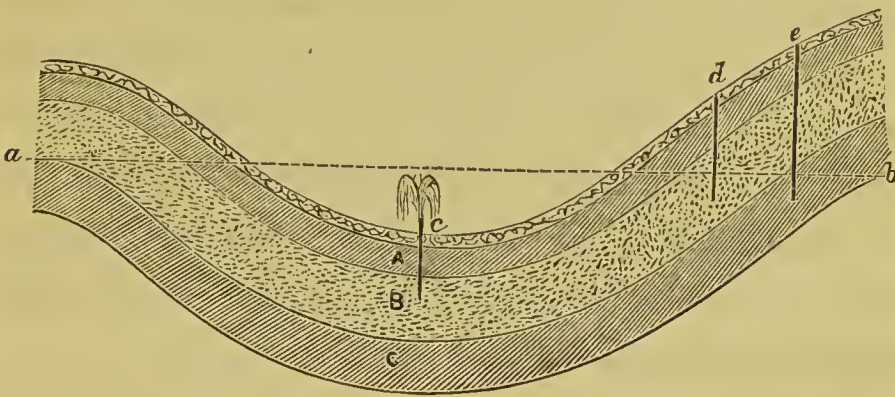
brought into action. The generality of them merely enter strata through which water passes in its transit

to lower levels, and are therefore more liable to fluctuation in the quantity of water they produce; sometimes failing altogether. I should imagine that both Jacob's Well and En Rogel are of this latter description. Let *A* represent a body of porous strata, overlying *B*, an impervious substratum, having at *c* a basin-shaped depression. It is manifest that such portion of the porous strata as lies in the hollow below the dotted line, *a b*, must be in a state of perpetual saturation; and that if a shaft be sunk at *D*, till it reach below the line *a b*, the portion of the shaft beneath that line must become filled with water, and form a serviceable well; from which, nevertheless, the water must be raised by buckets, or machinery of some kind, involving labour and expense, and therefore deep wells of the ordinary kind are not so convenient as a description which may be formed in some localities, under certain geological conditions, and in which—under peculiarly favourable circumstances—the water rises above the surface of the ground in an overflowing fountain.

SECTION 2.

ARTESIAN WELLS.

The last-mentioned are termed Artesian wells, and are merely a variety of the former ; the peculiarities of which, consisting chiefly in the *necessary* presence of an overlying impervious stratum, and of a subjacent basin-shaped one, either of which is only an adventitious circumstance in an ordinary well, a diagram, again, will best illustrate.



SECTION ILLUSTRATIVE OF THE PRINCIPLE OF ARTESIAN WELLS.

Let *c d e* represent the undulating surface of a district ; *A* an impervious stratum, underlying the usual surface soil of the country ; *B*, a subjacent deposit of sand, gravel, or porous rock, in a state of

saturation up to the dotted line $a b$, and overlying c , a basin-shaped impervious stratum.

Under these circumstances, if a shaft were sunk or a boring made at c , a point on the surface of the land lower than the line of saturation, $a b$, until it reach the water-bearing stratum, B , a *jet d'eau* would be instantly formed, in height proportioned to the altitude of the line, $a b$, above it; in ordinary terms, proportioned to the "*head of water*," or hydrostatic pressure, operating from $a b$ downward.

If a boring were effected at d , a point on the rising ground above the line of saturation, $a b$, and continued downward through B , the saturated body, till below the line, $a b$, the water in that case would not reach the surface of the land, for it could rise no higher than the level of the fountain head, or limit of saturation marked by the line $a b$; yet this likewise would be a true Artesian well.

If a boring were made at e , although it should penetrate to the same level as that at d , no water whatsoever would be found, for though a portion of it, above the line $a b$, should lie in the permeable body B , yet there being at a , upon the line $a b$, a means of escape for the water over the edge of the basin formed by c , the state of saturation, theoretic-

cally speaking, could not extend higher than that line, and, practically speaking, not *much* higher; consequently, thus far, no water could be found. And as to the remainder of the boring, beneath the line *a b*, it would lie altogether outside the water-bearing body B, and in the impervious stratum c; and so it would happen that, though not far distant from the successful boring at *d*, and relatively of an equal depth with respect to the line *a b*, all toil and cost bestowed on it would be lost, which shows that much caution and careful investigation is necessary before the sinking of an Artesian well should be undertaken.

The sizes of the bores in Artesian wells vary commonly from three to eighteen inches. It is usual to sink a shaft some distance, and in addition occasionally to run an adit or tunnel, to act as a receptacle for the accumulation of the water, when it rises through the boring made at the bottom of the shaft to the water-bearing stratum.

Artesian wells are so named because that at Artois, in France, the principle upon which their efficacy rests was first brought prominently into notice, though Artois was not the first place where it had been practically applied in the construction of wells.

The expense of boring an Artesian well is much less than that of sinking a shaft for one of the ordinary kind. The boring of 252 feet through tertiary strata in Lombard Street, in London, cost £200; and from various other instances it appears that the cost of boring, up to 100 feet, does not exceed 4s. per foot; between 100 and 200 feet, from 6s. to 10s. per foot; and between 200 and 300 feet, from 10s. to 16s. per foot.

A boring at Loughton, in Essex, 535 feet deep, of which 324 was through tertiary strata, and the remainder through chalk, cost £750, or nearly 30s. per foot. The following statement of the expense of boring at the bottom of a shaft in the Model Prison, London, will throw additional light upon the subject: 45s. per foot, including the cost and insertion of cast-iron pipes, for 180 feet in tertiary strata, the diameter of the hole being $10\frac{1}{2}$ inches; 27s. per foot for boring through chalk, with a $7\frac{1}{2}$ -inch augur, at the bottom of the $10\frac{1}{2}$ -inch hole, exclusive of pipes or the cost of insertion; or with perforated copper pipes, and inserting of same, would have cost 10s. 2d. per foot extra.

Artesian wells, averaging from 130 to 150 feet in depth, sunk at Cambridge, through gault, cost from £15 to £20 each, total expense.

The expense of boring a 6-inch hole at the bottom of the Green Lane Well at Liverpool, mentioned in Chap. V., Sec. 1, was as follows: For the first 20 feet, £2 10s. per foot; for second ditto, £3 per foot; for third ditto, £3 10s. per foot; for fourth ditto, £4 per foot; for fifth ditto, £4 10s. per foot.

Among the deepest borings, perhaps, in the world are that of the Abattoir de Grenelle, at Paris, 1,807 feet in depth, executed between 1833 and 1841, by M. Mulot, under the superintendence of MM. Arago and Walferdin; and one at Kissingen, in Bavaria, 1,878 feet in depth. Mr. Prestwich states the total cost of the former was £14,500, including some unusual expenses; viz., a double set of tubes, and a large construction over the well; the first 1,312 feet cost £4,000, but the *whole* work could be now executed for about £10,000. This boring passed through 148 feet of tertiary strata, 1,378 feet of chalk, and 291 feet of green-sand and gault; it was commenced with a diameter of 20 inches, reducing gradually, till at a depth of 1,771 feet it was 8 inches, down to which it was lined with tubing, but lower than that it was not lined. The internal diameter of the tube in the narrowest portion of the bore was $6\frac{3}{4}$ inches. According to an article in the

Constitutionnel, 4th March, 1841, the yield of the well was 880,387 gallons in 24 hours, at a temperature of $82\frac{1}{2}^{\circ}$ Fahrenheit, about 11° less than the mean temperature of the Union Mines in Cornwall, which are 1,770 feet in depth. The cost of the latter boring—that at Kissingen, in the new red sand-stone—was £6,666.

A still deeper well-boring than either was commenced at Passy, in 1855, and completed in 1861. It has reached the depth of 1,923 feet; at which point the Artesian spring was tapped, and the water rose to the surface at the rate of 5,582,000 gallons per day, which has since diminished to 2,000,000 gallons per day—the diameter of the bore is two feet.

The expense in England of several borings, through chalk, to an average depth of 1,000 feet, has been about £3,000 each.

Lately, by the application of steam power and improved machinery, the expense of boring has been much reduced—several holes having been sunk to the depth of about 825 feet, for from £600 to £1,000 each, being about £1 per foot on the average, including tubing and all expenses.

Shallower borings have been made in France of various depths down to 600 feet, at prices ranging from

5s. to £1 per foot ; whilst one 666 feet deep, through gault and green sand, cost £1,216 ; showing how greatly the nature of the rock affects the expense.

By the use of the best machinery, borings have been recently effected at the following cheap rates : 200 feet for about £120 ; 1,000 feet deeper for £600 extra. It is confidently asserted as practicable, that a boring up to three feet in diameter could, if required, be executed to the depth of 3,000 feet. At Manchester, an experimental hole, 15 inches wide, and 212 feet deep, in hard grit stone, has been completed in the short space of 141 hours.

SECTION 3.

GEOLOGICAL STRUCTURE OF THE LOCALITY OF JERUSALEM INCOMPATIBLE WITH ARTESIAN WELLS.

As shown in the foregoing paragraph, a basin-shaped stratum, possessed of a certain degree of stanchness—containing within it a water-bearing deposit, underlying another impervious stratum, capable of “*keeping the water down*,” till pierced through—are essential conditions, without which an Artesian well cannot exist.

These conditions must be sought for in vain in

the locality of Jerusalem ; no basin-shaped impervious stratum lies there beneath the porous rock formation upon which the city stands, nor is there any superstratum of impervious matter ; and even though these did exist, it is evident that the *chasm* of the Kidron, becoming deeper and deeper as it approaches the Dead Sea, would have all cut through ; causing a fracture in the side of the "basin," above the lowest point of which the contained porous rock could not remain in a saturated condition.

SECTION 4.

PHYSICAL FEATURES OF THE COUNTRY FAVOURABLE TO THE CONSTRUCTION OF RESERVOIRS.

Though the geological structure is unfavourable for the sinking of Artesian wells, nature has provided other means for an ample supply of water, if to the full extent taken advantage of. Surface springs exist throughout the land in various places ; and large stores of water might be obtained from wells of the ordinary kind, if sunk to the requisite depth ; but it is not upon these that Jerusalem, or Syria in general, must depend for her chief supply.

The physical geography of the country—in the

contour of its hills and valleys, with great upland slopes facing each other, and meeting in narrow gorges—presents the utmost possible facility for the formation of lakes and reservoirs on a grand scale, and by the simplest means—namely, the construction of short embankments across those necks or gorges.

And equal in importance to roads, without which the country can never prosper, this is a first great national work of improvement that should be undertaken.

SECTION 5.

DEPTH OF RAIN-FALL AT JERUSALEM.

The rainy season commences about the middle of October, and usually terminates towards the end of April; after which no rain falls, except an occasional shower during the month of May.

The following table, from Mr. Beardmore's work, shows particulars of the rain-fall during twelve years; with the mean temperature of each year, and the elevation of the city above the Mediterranean and the Dead Seas. From it, it appears that there are seven rainy months in the year at

Jerusalem, and that the average annual depth of rain there is no less than 65 inches; that on one occasion it was over 104 inches, and the least was $29\frac{1}{2}$ inches:—

RAIN-FALL OF JERUSALEM,

2,749 feet above the Mediterranean, and 4,116 feet above the Dead Sea.

DETAILS OF MONTHLY FALL.

Period.	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1846	6.0	7.4	5.4	0.0	0.0	0.0	0.0	0.0	0.0	4.0	6.4	0.0	29.2
1847	9.8	32.8	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	67.6
1848	24.6	5.8	0.0	0.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0	15.2	48.2
1851	14.6	24.0	4.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	1.8	9.4	60.0
1852	13.6	25.0	8.8	0.0	2.4	0.0	0.0	0.0	0.0	0.0	6.0	12.4	61.0
1853	4.2	4.0	21.4	1.2	2.0	0.0	0.0	0.0	0.0	3.8	0.0	6.4	52.2
1854	13.2	20.0	24.8	10.8	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.2	79.0
1855	32.6	13.0	8.8	2.4	0.0	0.0	0.0	0.0	0.0	0.0	14.8	4.2	61.0
1856	17.6	21.8	10.2	24.8	0.6	0.0	0.0	0.0	0.0	1.4	6.6	17.0	94.0
1857	13.0	57.2	4.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	21.8	104.2
1858	23.2	23.6	1.6	5.2	shower	0.0	shower	0.0	0.0	0.0	0.0	21.8	75.4
1859	11.2	8.2	16.8	6.2	0.0	0.4	0.0	0.0	0.0	4.4	2.8	0.8	50.8
Mean..	15.3	20.2	9.3	4.8	0.6	0.6	0.0	0.0	0.0	1.1	3.3	10.4	65.0
Mean } Temp. }	47.7	53.7	60.0	54.7	66.7	66.7	77.3	72.5	72.2	68.4	58.9	47.3	62.6

From Dr. Barclay's thermometrical observations it appears that the highest temperature registered by him, 92° F. in the shade, and 143° in the sun, was attained in August; and the lowest, 28° , occurred in January.

CHAPTER V.

SECTION 1.

QUANTITY OF WATER OBTAINABLE FROM SPRINGS AT JERUSALEM.

From the nature of springs, as explained in Chap. IV., Sec. 1, the limited extent of the summit of the hill upon which Jerusalem stands, and the proximity of the ravines around it, it is quite impossible that a true spring, yielding an appreciable quantity of water, could now, or ever did, exist within the walls.

That no spring, concealed or otherwise, exists there, could be proved to any observer, without even entering the city, by walking along the surrounding *wadies*, and remarking that no water issues from the hill-sides in any place, save at the Fountain of the Virgin, which supplies Siloam; and even there, as before mentioned, in the dry season the quantity is but little more than might be supplied

from the waste and leakage of the city overhead, being, of course, about the same as the quantity of water supplied; which, as shown in Chap. I., Sec. 4, may be estimated at 66,910 gallons per day, or less than $46\frac{1}{2}$ gallons per minute—from which quantity, small as it is, 12,500 gallons per day are shown to be derived from En Rogel, which at that season is chiefly supplied by this very well itself, and conveyed to the city by animal labour, but this would make so very inappreciable a quantity per minute, that it may be well disregarded in estimating the amount which the Fountain of the Virgin might receive by subsidence from the city, in addition to any water that might percolate into it from the Valley of Jehoshaphat, which in the dry season must be extremely little, as the fountain is too shallow to partake much of the property of a deep well.

It appears to me a reasonable estimate, that considering the depth of the Fountain of the Virgin, its position with respect to the city, and the concomitant circumstances, that one-fifth of the waste water of the city in the dry season should find its way by gravitation into it; whilst the water which constitutes the other four-fifths partly remains in the cesspools, to be slowly evaporated, partly becomes

evaporated from the surface of the streets and yards, and partly subsides into the earth in other quarters.

Thus, 66,910 gallons per day being the quantity supplied to the city, one-fifth of it, or 13,382 gallons per day, may be estimated as finding an exit at the Fountain of the Virgin ; which yields altogether in the dry season, as estimated in Chap. I., Sec. 4, about 14,400 gallons per day. Therefore, deducting 13,382 from 14,400, there remains only 18 gallons per day as derivable by percolation from the Valley of Jehoshaphat ; and that is about the quantity which I would have thought probable, even if I had not entered into any formal calculation.

While I was at Jerusalem, an announcement was made, which created some excitement, that a spring, from which issued a running stream, had been discovered beneath the Latin Convent of the Daughter of Zion, adjoining the Ecce Homo Arch, in the Via Dolorosa. After some demurring, I obtained permission to see it, accompanied by Mr. Ducat, a hotel-keeper in the neighbourhood, and the superior monk connected with the Convent. Quite in accordance with my expectation, it proved not to be a true spring, but a mere leakage of water through a partition wall, deep under ground, into an ancient vault, the descent to which was by a ladder.

It had been recently discovered in sinking the foundation of a building pertaining to the Convent.

This vault is of a very remarkable character, and I trust it may be further examined by others, when extensive excavations shall have been made, as it is calculated to throw light upon the ancient topography of the city. Its direction lies nearly N.W. and S.E. Built and arched over-head with square astlar masonry, and of width sufficient to admit of a dozen men marching abreast, it may have been a subterranean military passage for strategic purposes, leading from the fortress of Antonia, which stood at the N.W. angle of the Temple space, to without the city wall. But for whatever purpose it was originally intended, succeeding ages have made use of it as a cesspool; for when I saw it, which was shortly after its discovery, it contained several feet in depth of sewage matter.

A second wall ran across it, which prevented my tracing it farther than about seventy or eighty yards in length; along fifty of which I was enabled to walk upon an accumulated ridge of earth and old building materials.

The extract given as an Addendum to this work is from Mr. Williams' Paper, read before the Royal

Institution, referred to in Chap. II., Sec. 6 : and in it will be found further important particulars respecting this remarkable vaulted gallery, and learned speculation as to its nature and connexion with the Temple and the Fortress of Antonia.

But though there is no hope of finding springs within the city, outside the walls the case is otherwise. The Well of the Virgin has been already described (Chap. II., Sec. 6). Upon it I place little value; for my conviction is, that so soon as Jerusalem shall have been provided with a good system of sewers to carry off all refuse water, and the cisterns properly stanchèd, no water will be found in this well during the dry season, except such as may occasionally be let into it from the great cistern beneath the Haram, which seems to be the cause of the present irregular rising of the water; and when this well shall fail, the stream at Siloam, which is dependent on it (Chap. I., Sec. 4), shall fail also.

En Rogel claims attention, but before entering into particulars respecting it, it may be well to advance a few general observations.

Taking every circumstance of climate, &c., into consideration—and drawing a parallel between Syria

and other countries where scientific research, as regards the nature of springs, has elicited a knowledge of the proportion of rain which sinks into the ground—the conclusion I have arrived at is, that in the uplands of Judea, undulating as they are, and although they consist of a light, porous soil, resting upon a mass of soft white limestone, not far removed from the texture of indurated chalk, about 10 per cent. of the total annual rain-fall of 65 inches in depth, equal only to $6\frac{1}{2}$ inches, subsides beyond the limit of three feet, for the support of deep wells and natural springs.

Dr. Dalton ascertained that on the new red sandstone soil of Manchester (in a temperate climate, and a level district), 25 per cent. of the whole annual rain-fall, which there, upon a mean of twenty-two years, commencing in 1813, according to Beardmore's tables, averaged $37\frac{3}{8}$ inches, sank to the depth of three feet. And Mr. Charnock established that at Ferrybridge, in Yorkshire, upon a magnesian limestone soil, $19\frac{6}{10}$ per cent., or little more than $19\frac{1}{2}$, penetrated to that depth.

Mr. Dickinson, by a long series of experiments, ascertained that near Watford, in the neighbourhood of London, upon gravelly soil, overlying chalk, in

the month of April, 21 per cent. descended below the depth of three feet ; in May, about 6 per cent. ; in August, the hottest month in the year, when the influence of temperature to cause evaporation is at its height, less than $1\frac{1}{2}$ per cent. ; and in December, the coldest month, that all the rain which fell descended below that depth.

It must be borne in mind that this latter series of experiments has regard only to a gravelly soil ; and that no description of land experimented on, of which we have trustworthy records, bears an *exact* resemblance to that about Jerusalem ; but from such analogy as we can establish, and all circumstances being considered, 10 per cent. appears a proper estimate.

En Rogel is situate 1,060 yards from the S.E. corner of the Haram, and in its present state, as mentioned in Chap. I., Sec. 4, produces but little water during the driest portion of the year ; but being in a favourable position, it would, if sunk to a proper depth, command the "*draft*" of water from a space of about two square miles, or 1,280 acres ; and assuming that of the 65 inches in depth of annual rain-fall, $6\frac{1}{2}$ inches sinks deep into the earth, it would give 23,595 cubic feet per acre, which, multiplied by

1,280, the number of acres in two square miles, would be 30,201,600 cubic feet, equal to 188,219,995 gallons per annum; or, if apportioned equally throughout the year, 515,673 gallons per day, within the "*power*" or "*draft*" of this well, and at so great a depth as not to be diminished by evaporation.

But the actual rate per day at which this water should percolate into the well would vary, and depend so much upon the seasons, and the porosity of the rocks, the density and retentive power of which have not been accurately ascertained, that we can make only an approximate calculation respecting it; however, to insure against the possibility of over-estimating in the matter, making liberal allowance for the irregular rate of flow, and loss of portion of the water by subsidence, &c., let us take half the above quantity, or 257,835 gallons per day, neglecting a fraction, as the minimum. In all large quantities, for sake of simplicity, I have omitted fractions, and set down the whole numbers next in order, above or below.

That this is a moderate estimate, may be inferred by comparing it with the yield of several wells at Liverpool, as set forth in the following table:—

YIELD OF WELLS AT LIVERPOOL.

Denomination of Well.	Depth in Feet.	Average yield in 24 hours, during the year 1854, as given by Mr. Stephenson.
Bootle . . . {	45, with 16 holes at bottom, some of them 600 feet deep.	{ 881,008 galls.
Bevington Bush	150	252,737 „
Soho. . . .	123	509,732 „
Hoatham Street	110	229,201 „
Water Street .	150	402,344 „
Windsor . . {	210, with a hole at bottom 214 feet deep.	{ 1,020,493 „
Green Lane . {	185, with a hole at bottom 98 feet deep.	{ 2,413,068 „

Beardmore, under the heading "Supply of Wells," says: "We are naturally led into this subject, when treating of the quantity of water falling over the surface, and percolating through the ground; for it is evident that the supply of wells depends upon the freedom with which rocks will permit the passage of water, and on the absence of free discharge at escarpments of valleys to which the strata may dip. Faults must of necessity drain away the water due to the strata which they intercept, the extent de-

pending upon the nature of such faults, and the free character of the rocks. As faults are generally numerous, it is evident that the supply of wells must vary according to the accident of position and depth; but this rule is not without exception, for there are many districts where, with the pervious beds lying in great depth on impervious rocks, water is always to be found at the point where it would naturally be deposited by gravity. The question is, then, how much water filtrates through and into the lower beds of rocks, or would do so if it were constantly pumped away as it accumulated; or, what is the same thing, how much is relieved by springs, having passed through more or less depth of stratification, and relieved itself by natural agents into the ordinary channels of discharge."

I have spoken in Chap. I., Sec. 4, Chap. II., Sec. 5, and Chap. III., Sec. 1, of Ain es-Suâni, a point in the Valley of Jehoshaphat, about 530 yards above the N.E. angle of the city wall, where it is possible a covered spring may exist, from which the water may be conveyed by a tunnel to the Fountain of the Bath of Healing, within the city. It is a choice locality, where a well, if sufficiently deep, would command from Scopus and the adjoining hills the

“draft” from about two square miles, like En Rogel; and we may, therefore, infer that it would yield about the same daily quantity of water—a minimum of 257,835 gallons.

Another favourable locality for a deep well lies near the head of the Valley of Hinnom, some distance from the Upper Pool of Gihon. It would command the “draft” from about one square mile, and therefore the minimum daily yield of water might be estimated at 128,918 gallons per day.

There is one other locality where a well might be sunk with advantage, about 1,080 yards below En Rogel, in the Glen of the Kidron, at a point where two lateral *wadies* fall into it; one of which is named Geddoom. A well at this point would command a “draft” from the neighbouring hills and wadies of about $1\frac{1}{2}$ square miles, and might, therefore, be expected to yield, if no hidden fault exists in the strata, a minimum of 193,377 gallons per day.

About mid-way between it and En Rogel, an ephemeral stream breaks up from the ground in winter, caused merely by a discharge from En Rogel, when the water rises after heavy rain, and in part escapes through a fissure in the rock, or a porous stratum, a few feet below the level of

the well's mouth ; it is, therefore, unworthy of much notice. It is named Ain ed-Durrage. It may be observed that one of the names of the Fountain of the Virgin is somewhat similar—viz., Ain Um ed-Durrage, or Deraj, the Fountain of the Mother of Steps.

Adding together, as follows, these four estimates, it appears that, upon a moderate calculation, 837,965*

* While at Jerusalem, I received the following letter from Sir Culling Eardley, Hon. Secretary to the Syrian Improvement Association :—

“Bedwell Park, Hatfield, Feb. 6, 1862.

“Sir,—You can do me a favour, should you be in Jerusalem when H.R.H. the Prince of Wales is there. He will be, as you are probably aware, accompanied by the Rev. Canon Stanley, Professor of History at Oxford, and author of the celebrated work on the Holy Land.

“I have spoken to him to see you about the subject of the Artesian well ; and probably you will be good enough to call upon him with that view.

“You will perhaps inform Canon Stanley what the expense is likely to be, what local persons would be likely to contribute, and in what spots there would probably be found water.

“I am, Sir, your faithful Servant,

“C. E. EARDLEY.

“To J. I. Whitty, Esq., C.E., &c.”

Accordingly, upon the arrival of the Prince, I called on Dr. Stanley, and explained to him my views, in all of which he appeared to coincide, which gives me additional confidence in the opinions herein set forth.

gallons per day is the quantity, which, taken as a minimum, might be procured from deep wells in the vicinity of Jerusalem.

PROBABLE MINIMUM YIELD OF WELLS PROPOSED TO BE
MADE OR DEEPENED AT JERUSALEM.

Well or Locality.	Gallons per Day.
En Rogel	257,835
Ain es-Suâni	257,835
Upper part of Hinnom	128,918
Valley of Kidron, below Ain ed- Durrage }	193,377
Total	837,965

SECTION 2.

AMOUNT OF SURFACE WATER OBTAINABLE FROM
WITHOUT THE CITY WALLS.

The next necessary inquiry is, as to the quantity which might be supplied to the city by means of surface drainage received into reservoirs. We have assumed (Chap. III., Sec. 3) that of the 65 inches of rain-fall, 45 per cent., equal to $29\frac{1}{4}$ inches in depth, flows off either upon the surface of the land, or at a depth not exceeding three feet ; this would yield

106,177 cubic feet of water per acre, or 67,953,600 cubic feet per square mile.

The catchment-basin or area which might contribute water to Solomon's Pools, and from which, by repairing the existing aqueduct, the great cistern beneath the Haram and other cisterns in Jerusalem might be supplied, is about five square miles in extent; capable of yielding by surface drainage 339,768,000 cubic feet, or sufficient to replenish the pools nearly $42\frac{1}{4}$ times in each year; which shows that Jerusalem, even in Solomon's time, was not supplied, in the dry season, with a tithe of the water which it might have had from these pools. In our own country, the capacity of reservoirs for storage purposes should be proportioned at from $\frac{1}{2}$ to $\frac{1}{3}$ the volume of water which their respective catchment areas are capable of yielding throughout a year; and in Syria, where the declivities are so steep that most of the water runs to waste unless immediately caught, precautions are especially requisite; and the capacity of reservoirs there should bear a still nearer proportion to the volume of water which, according to the advantage of their positions, might flow into them. That efficient means had been used to direct all the drainage into them I must

therefore doubt; especially as I could find in the district no traces whatsoever of the drains remaining, save two surface drains running into the Lower Pool; but this circumstance is no very convincing proof of their not having existed, for that all traces of shallow drains should have disappeared after so great a lapse of time could not be marvelled at.

About $1\frac{1}{2}$ square miles, on too low a level to be rendered available for the service of the Upper Pool of Gihon, might be made to contribute to the *Lower* Pool of Gihon. This would give 101,930,400 cubic feet of water.

A district of about $2\frac{1}{4}$ square miles might be made to contribute to the Upper Pool of Gihon, from which the Pool of Hezekiah might be replenished. This would produce 152,895,600 cubic feet of water.

The uplands N. and N.W. of the city, an extent of about $1\frac{1}{4}$ square miles, are sufficiently elevated to supply the cistern outside the Damascus Gate, mentioned in Chap. II., Sec. 15, and a reservoir which should be constructed within the walls, in the same locality; and likewise the Pool of Bethesda, Birket el-Hejjeh, and Birket Hammam Sitte Myriam; for particulars respecting which see Table 1, Chap. V.,

Sec. 7. These uplands would produce 84,942,000 cubic feet of water.

Scopus, the Mount of Olives, and the range of hills of which they form part, present a surface of about $2\frac{1}{2}$ square miles, in a favourable position, and sufficiently elevated to supply water to the *highest* portions of the city. It would produce 169,884,000 cubic feet of water; which might be conveyed "on the level," by an aqueduct round the head of the Valley of Jehoshaphat; or by means of hydrostatic pressure through a metal or stone-ware tube, adapted to the surface of the ground, across the valley by the shortest course.

QUANTITY OF WATER WHICH MIGHT BE PROCURED BY
SURFACE DRAINAGE FOR THE SUPPLY OF JERUSALEM.

Locality from whence.	Cubic feet per annum.
Solomon's Pools	339,768,000
Lower Pool of Gihon	101,930,400
Upper Pool of Gihon	152,895,600
District N. and N.W. of City .	84,942,000
Scopus, Mount of Olives, &c. .	169,884,000
Total	849,420,000

Adding these several items together, the result is 849,420,000 cubic feet of water, equal to

5,293,687,370 gallons per annum, or 14,503,253 gallons per day, which might be supplied to the city simply by surface drainage, and suitable reservoirs for its reception.

This would be upwards of 713 gallons per day for each individual—more than double the quantity which each inhabitant of ancient Rome possessed (as mentioned in Chap. I., Sec. 2), or than each inhabitant of the city of New York possesses at the present day. And great as the quantity appears, the statement cannot be controverted, unless it can be shown that there does not exist around Jerusalem and around Solomon's Pools together, eleven square miles of land on a higher level than the city, and one and a-half square miles commanded by the Lower Pool of Gihon, on a higher level than it, though lower than the city; or unless it be shown that the evaporation in the region is so great, or the porosity of the soil so unusual, that 45 per cent. of the annual rain-fall cannot escape by surface drainage: in other words, is not capable of being collected.

I have taken the elevations from the best maps, sections, and models of the country that exist, and if they be in any degree inaccurate, a *proportionate* reduction or addition—as the case might be—should

be made regarding my figures ; the *principle* laid down being that *only* upon which a true calculation can be founded.

By adding to the above quantity, which might be obtained by surface drainage from without the city by simple means, that which might be collected of rain-water from the available surface within the walls (not including the space occupied by streets)—as shown in Chap. I., Sec 4, and that which might be probably obtained from deep wells, as shown in Sec. 1 of this Chap—we get a total of 16,275,872 gallons daily.

POSSIBLE DAILY WATER SUPPLY BY COMPARATIVELY
INEXPENSIVE MEANS.

Surface drainage from without the City.	14,503,253
Rain-water within the Walls . . .	663,726
Deep Wells in the vicinity . . .	837,965
Total . . .	16,004,944

which, at far less comparative expense than that incurred in other places, would supply a population of 3,200,989 persons (larger than that of London, which, according to the late Census, is 2,803,989 persons), should the city ever prosper to that extent, with five gallons of pure water per day for each.

inhabitant. This, it is true, is the quantity estimated in Chap. I., Secs. 1 and 6, as sufficient only for necessities; but for both necessities and comforts of life, as shown in same Chap., Sec. 1, fifteen gallons per day for each inhabitant, or three times the above quantity, is that which is requisite. Therefore, taking that as the basis, a population in Jerusalem of one million and sixty-seven thousand souls might be easily supplied with abundance of water—fifteen gallons a-day for each individual.

And this might be accomplished without the formation of any artificial impervious surface, by which—as shown in Chap. III., Sec. 3—the quantity might be *greatly* increased, and independent, also, of the additional quantity which might be had from Neby Samwil, as shown in Chap. II., Sec. 12.

Therefore it is plain Jerusalem has in itself the most necessary element of strength and prosperity, and that, without the recurrence of any miracle, the prophecies in its behalf may be fulfilled, to render it a mighty city, more glorious than it ever yet has been.

SECTION 3.

ANCIENT MEANS OF WATER SUPPLY—RESERVOIRS—
AQUEDUCTS—WELLS.

The means of supply in ancient times, when water was confessedly abundant, were *reservoirs*, *aqueducts*, and *wells*; and these means are still available in all their fulness, requiring only to be taken advantage of to the utmost extent, to produce even a greater quantity of water than at any former period.

SECTION 4.

COST OF CONSTRUCTION REDUCED BY IMPROVEMENT
IN ART AND MODERN APPLIANCES.

In addition to the foregoing, increased knowledge of the laws of nature, improvement in art and modern appliances, have reduced the cost of construction; and thereby the city might obtain, not only a larger supply, but at a cheaper rate than formerly.

SECTION 5.

EXTENT AND DESCRIPTION OF PRESENT PROPOSED
WATER-WORKS.

To carry out improvements in Jerusalem commensurate with its ultimate requirements, and

to the full extent which its natural capabilities render practicable, would require a far greater amount of capital than could possibly be hoped for in the outset of the charitable project now under consideration for its relief.

I have hitherto endeavoured to draw attention to facts and circumstances, with a view rather of showing what good might be performed with a large capital, than that which is barely essential, and what it is possible to effect with the capital in hand.

I shall now mention the most essential requisites, and draw up an estimate for the performance of works, not exceeding £3,000, leaving it to the magnanimity of Christians and Jews to subscribe funds to carry out to a state of completion all the suggested improvements, and thus both may rejoice, and both may say with truth, "We have conferred no transient blessing upon 'The City of our Solemnities.' " *

As shown in Sec. 2 of this Chap., nearly eighty-five millions of cubic feet of water in the year could be procured from the high lands N. and N.W.

* Isaiah xxxiii. 20.

of the city, by making a suitable arrangement of drains and channels to intercept the rain-water, and convey it into the reservoir existing outside the Damascus Gate, described in Chap. II., Sec. 15; and, as auxiliaries to it, into the Pool of Bethesda, Birket el-Hejjeh, Birket Hammam Sitte Myriam, and any other tanks and reservoirs that might be available: for, as shown by the Table in Sec. 7 of this Chap., the receptacles enumerated are adequate to contain but a very small proportion of the water that might be collected from the drainage of the district.

All the water of the reservoir outside the Damascus Gate—it being in a convenient situation for the purpose—should be reserved exclusively for flushing the sewers spoken of in Chap. VI., Sec. 2; therefore the enlargement and repairs of it, with the formation of its tributary drains, are among the first necessary works that should be undertaken.

Together with these, a systematic arrangement of drains should be formed, whereby the Upper Pool of Gihon, which supplies the Pool of Hezekiah, might receive its due quantity of water—which, as shown in Chap. V., Sec. 2, would amount to nearly one hundred and fifty-three millions of cubic feet in the year.

The original aqueduct from the Pools of Solomon (see Chap. II., Sec. 11), which is now perfect only as far as Bethlehem, might be repaired ; and whilst some of the water which the pools supply might be let off there, for the advantage of the Bethlehemites, the greater portion should be conveyed to Jerusalem, to fill the covered reservoir in the Mill Valley, mentioned in Chap. II., Sec. 13, near the Haram entrance, called the Gate of the Chain, which, by an overflow-pipe, might communicate with the Great Reservoir beneath the Haram ; from which a constant stream would descend into the Fountain of the Virgin, and thence the inhabitants of Siloam, likewise, would derive the blessing of being no longer condemned to the using of water having a "peculiar" taste ; their vegetable gardens would be more copiously irrigated, and the village, pleasantly situated as it is in a romantic glade, would increase in prosperity and population, and become a desirable suburb of the city.

This is the most inexpensive course by which the water from the pools could be conveyed to the city ; for since the aqueduct in question was repaired by Sultan Mohammed Ibn Kelaûn, it has not been very materially injured. Though the stream is at present diverted from its channel at Bethlehem, so lately as

the year 1852 it flowed to Jerusalem, but barely reached its destination, in a most attenuated state ; so many outlets had been made in the pipe by the felahs, through whose land it passes, each desirous to obtain a stream from it for the irrigation of his own crops and garden ; but it is only on the grounds of economy that the adoption of it could be recommended, it not being the *best* course by which the water from the pools might be brought to the city.

As mentioned in Chap. II., Sec. 11, there exist substantial remains of a more modern aqueduct from the pools to Jerusalem, from which not only all the benefits which the old one presents could be derived, but also the great additional advantage—which by no means should be overlooked—of being able to deliver the water at a far higher level within the city. It would therefore not be advisable to imitate the example of the above-named Sultan, by repairing the inferior aqueduct, originally constructed on an imperfect principle, before science had made such advancement, as to give even Solomon that acquaintance with the laws of nature which rendered those of after times in many things his superiors.

It would be of the greatest importance if funds can be procured to reconstruct the Aqueduct of Herod,

assuming the conjecture right which ascribes to him the construction of the second aqueduct; and not to give up a vast benefit for the sake of a very disproportionate saving of expense.

By Herod's Aqueduct water was conveyed from the pools by a much shorter route, and delivered in the city at a much higher level than it had previously been by that of Solomon; the length of the former being little over seven miles, and that of the latter no less than twelve miles and a quarter. The former delivered the water near the Jaffa Gate, probably into the Pool of Hezekiah on the one side, and to the courts and fountains of the palace upon Mount Zion on the other. For Josephus states that within the precincts of Herod's Palace were "brazen statues, through which the water ran out." Part also might have been conducted to the Great Cistern beneath the Temple area, by means of the aqueduct lately discovered by Mr. Johns, when sinking the foundation of the English Church. The Aqueduct of Solomon entered the Temple enclosure from the south, at the low level of the Great Cistern, and supplied only it. The roof of the cistern is about 10 feet beneath the surface of the ground, which is 192 feet lower than the margin of the Pool of Hezekiah. Conse-

quently, Herod's Aqueduct delivered the water at an elevation of about 202 feet above the other.

The table and extract in the note* from Dr.

	ELEVATION ABOVE EN ROGEL. Feet.
* Pool of Siloam	117
Kidron Valley, opposite Absalom's Pillar	223
Base of S.E. corner of Haram Wall	348
Mugaribeh Quarter	350
Mount Ophel, immediately south of the Haram	377
Mount of Corruption	422
Top of wall at S.E. corner of Haram	425
Top of Mission House [American]	461
North East corner of City	471
Bethany Mount	484
Mount Zahara	498
Hill of Evil Council	506
Zion at S.W. corner of City Wall	511
Average height of Zion	521
Jaffa Gate	534
Bezetha [summit]	550
N. W. corner of City	571
The site of Jebel et Târ Village	635
Wely, east of it	653
Wely Kamah	655
Rock hillock on an elevation of Olivet, 1,000 feet north of Jebel et Târ Village	678
Northernmost summit of Olivet	708

The Village of Jebel Târ is 412 feet above the Kidron at "Absalom's Pillar;" it is 104 feet above Zion, and 207 above the Haram area. The south-east angle of the Haram wall, at its base, is 125 feet above the Kidron Valley at "Absalom's Pillar," as Tantoun Pharoön is usually called. Mount Zion is 404 feet above Siloam.

Barclay show the elevations of the principal points in and near the city above En Rogel, which is 129 feet higher than the part of the Kidron, about 1,080 yards distant, where Wady Geddoom falls into it. I am indebted to a paper by Mr. Poole, published in the *Journal of the Royal Geographical Society*, for information as to the difference of level between the deepest part of the lowest Pool of Solomon and the bottom of the Pool of Hezekiah; which gives

The north-west corner of the city is 163 feet higher than the Haram area; and the Haram area is 185 above the Kidron.

The greatest difference of level found within the limits of the two miles square embraced by the Map [Barclay's], is between the loftiest summit of Mount Olivet in the north-east corner, and the depression of the Wady en Nair [Kidron Valley] at its lower edge [the point where the Wady-Geddoom falls into it], 837 feet. Within the limits of the present city the greatest difference of altitude—that between the south-east and north-west corner—is 221 feet. The difference in the ancient city, under its widest extension, was probably about 530 feet.

The Holy City is elevated 2,610 feet above the Mediterranean, and 3,927 above the Dead Sea, according to Captain Lynche's estimate; but 2,749 according to aneroid indication. A few of the foregoing altitudes and depressions were ascertained with the level; some with an aneroid; but most of them by the quadrant. It is 210 feet higher than Damascus, but about 1,000 lower than Baalbec. Mount Zion is 148 feet lower than Neby Samwil, and 9 feet below the Frank Mountain—the ancient Beth-Haccерem—a celebrated telegraphic station in former times—but several hundred feet higher than its base.

the relative elevations of the pools to a fixed point within the city, from which all others can be deduced ; and without which my data would have been incomplete. But as it is now, I can put forward, without fear, a statement which must be most gratifying to all who love Jerusalem—viz., that at moderate expense a permanent stream might be caused to flow to the highest part of the city, from whence it could ramify to all other quarters.

Before I had been there many days, I mentioned to Bishop Gobat and to Canon Stanley, who was then at Jerusalem with the Prince of Wales, that, from the appearance of the country, and the rapidity of flow of the water in the aqueduct from the pools to Bethlehem, I was of opinion that they were on a higher level than the top of David's Tower ; and that, by a tubular aqueduct, a tank upon it might be kept constantly filled ; which being the highest point in the city—though the tower itself does not occupy the highest ground—would afford a good “ head ” of water, for the supplying of upper rooms of houses, public fountains, the extinguishing of fires, &c. But then the possibility of it was only a surmise ; now, it is “ good tidings,” its practicability having been established.

The deepest part of the Lowest Pool of Solomon is 81 feet above the bottom of the Pool of Hezekiah, in Jerusalem, which is 10 feet in depth; therefore it is 71 feet above the general level of the ground at that point, which is 6 feet higher than the street at the Jaffa Gate, and about 16 feet above the base of David's Tower. The tower itself being about 60 feet in height, water might be sent with considerable force to the top, under a pressure of 27 feet, and a tank there kept constantly filled: the "overflow-pipe" from which might fill the moat around the base of the tower, and convert it into a fish-pond, such as I have seen, with gold-fishes in them, in the courts of many of the houses at Damascus and Cairo, and in the Sultan's Palace at Constantinople, and such as ancient authors describe as formerly existing at Jerusalem; from whence a running stream might refresh other parts of the city; whilst a pipe from a lower part of the tank could distribute water for the supply of houses, reservoirs, *jet d'eaux*, &c., &c., throughout all quarters.

It gives me unalloyed happiness not only to surmise, but to be able to demonstrate, that Heaven has dealt bountifully with the earthly throne of the Great King, the centre of Christendom, and the hope

of the now scattered Tribes of Israel; and that the curse of scarcity of water exists only through man's neglect, and may be easily removed. A knowledge of what is possible, and a painful feeling of what is requisite, are the proper foundation upon which to base an opinion as to that which should be undertaken for the well-being of the city.

The following Table shows to what extent each "quarter," and some of the principal points in the city, are "commanded" by the lowest of Solomon's Pools. A still greater "head" of water might be obtained by commencing the aqueduct at the Second, or yet more so at the Upper Pool; but the quantity obtainable would of course be in a due proportion diminished, for the Lowest Pool receives "drainage" from part of the district not sufficiently elevated to discharge its water either into the First or Second.

RELATIVE ELEVATIONS

Of the most prominent points in Jerusalem, with respect—
Firstly, to the deepest part of the Lowest of Solomon's Pools—Secondly, to the highest ground within the City walls—Thirdly, to the top of Hippicus, or the Tower of David:—

TABLE 1.

	Feet.
Elevation of deepest part of Lowest Pool of Solomon	
above Top of Tower of David	27
„ North-west angle of City (highest ground within the walls)	40
„ General surface of ground at Pool of Hezekiah	71
„ Jaffa Gate	77
„ Bottom of Pool of Hezekiah.	81
„ Average level of Zion	90
„ South-west angle of City	100
„ North-east angle of ditto	140
„ Top of wall at south-east corner of the Haram	186
„ Base of wall at ditto outside (high embank- ment inside)	263

TABLE 2.

	Feet.
Depression of highest ground within City walls, at north- west angle below Top of Tower of David	13
Elevation of same above general surface of ground at	
Pool of Hezekiah	31
Above Jaffa Gate	37
„ Bottom of Pool of Hezekiah.	41
„ Average level of Zion	50
„ South-west angle of City	60
„ North-east angle of ditto	100
„ Top of wall at south-east angle of Haram .	146
„ Base of wall at ditto, outside.	223

TABLE 3.

	Feet.
Elevation of Top of Tower of David above highest ground	
within City Walls at north-west angle	13
Above General surface of ground at Pool of Hezekiah	44
„ Jaffa Gate	50
„ Bottom of Pool of Hezekiah	54
„ Average level of Zion	63
„ South-west angle of City	73
„ North-east angle of ditto	113
„ Top of wall at south-east angle of Haram	159
„ Base of wall at ditto, outside.	236

It is worthy of consideration whether it would not be advisable to allow the Bethlehemites the exclusive benefit of the water of the Third, or Lowest Pool, in which case they would not be likely to raise any objection to the project, which they might otherwise do, and the present aqueduct would answer their purpose without any repairs. Furthermore, I can state for their satisfaction, that, provided money can be obtained to complete the work, by the formation of a series of catchwater drains, to replenish the pool with the full available proportion of the annual rain-fall, and prevent the very great waste which now occurs, they would receive far more water from this single pool than they now enjoy from all three together.

I have given the subject for years deep and anxious

consideration, and having to a certain extent matured a plan, which, while it would bestow the greatest blessing on the Holy City, would do lasting honour to the nations who should promote it, and to the individuals who should further it, although they should "cast their gifts into the treasury out of their abundance;" and having ascertained beyond doubt or question the feasibility of the crowning project—namely, the bringing of water by a tubular aqueduct from the Pools of Solomon, either to the top of David's Tower, or to the highest point within the walls, at the north-west angle, overlooking Acra—I now respectfully submit it for modification and improvement to the better judgment of the Syrian Improvement Committee, and earnestly hope for their approval.

I doubt not that under such patronage the public, not only of this, but other countries, would readily subscribe to a project for the conveyance of water from the Pools of Solomon to Jerusalem; to the repairs of Herod's Aqueduct, so far as it can be made available; and to the reconstruction of the portion of it which had not been originally formed on the tubular principle, and which has now in great part disappeared. This aqueduct would in every respect possess advantages over that attributed to Solomon, the repairs of which

I should only recommend in the improbable event of the available funds of the Committee not exceeding the present amount.

The following two propositions I therefore submit for approval: First, that the good will of the Bethlehem people should be secured, by giving them the exclusive right to the water of the Lowest Pool, with that portion of the "catchment area" of the pools unitedly which, lying on too low a level to contribute water to the upper pools, especially belongs to it; and that the present aqueduct, as far as Bethlehem, be likewise appropriated to their use. Second, that an iron or fire-clay stoneware tubing, of nine inches—or, in default of sufficient funds, of five inches—diameter, be laid beneath the surface of the ground, in a nearly direct line from the deepest point of the Second Pool to the base of the Tower of David, at the Jaffa Gate, or of the ruin called Goliath's Castle, on the highest ground at the N.W. corner of the city, and that it be continued upwards to a capacious tank placed upon the top, that from it a descending pipe, with branches, distribute water to every part of the town where required. Or if the tubular portion of Herod's Aqueduct shall, upon digging to it, be found in a sufficiently serviceable state (as suggested to me by Dr. Barclay),

it should be made available, as far as possible, to lighten the expense; but, for reasons mentioned further on, I do not approve of utilising any other portion of it. I would also recommend some slight lateral deviations to be made from the ancient course in certain places, in order, as much as practicable, considering the levels and the nature of the ground, to straighten the tubing, and thereby diminish its length.

There are four handsome Saracenic drinking-fountains, now dry, to be seen in the streets: these should be each supplied with a minute pipe and stream of water. Certain of the public tanks should have pipes let into them. Water should likewise be conveyed through pipes to all hospitals, schools, and institutions.

One of these ornamental fountains is situate at the intersection of a cross street with that in the Mill Valley, along which I propose running the main sewer, and about 410 yards from the Damascus Gate. In the locality a great part of the streets are arched over, and houses built upon the arches; this is a common occurrence in Jerusalem and other Eastern towns. The custom probably originated in the necessity for economising space within the confined limits of walled cities. The arches likewise serve the purpose of affording shelter, and a cool retreat from the sun's rays.

I fully concur with Dr. Barclay in the opinion that the Moslem portion of the inhabitants should participate in the blessing which Christians and Jews are about to bestow as a free-will offering upon the city. A fountain of living water within the Haram would be to them a grateful offering, and tend in a great measure to disarm their prejudice. A *jet d'eau* might be easily formed there, and it would be very effective, on account of the comparative lowness of the situation. He also suggested to me, and I concur, that, in accordance with the custom of the country in such cases, a monumental fountain should be erected, somewhat similar to that on the embankment of the Lower Pool of Gihon, stating that, through the exertions of the Syrian Improvement Committee, the blessing of abundant water was restored. It might be placed either at the Jaffa or Damascus Gate, or perhaps the esplanade in front of the English Church on Mount Zion would be a more suitable position. Wherever located, it ought to be constructed as a *jet d'eau*. A lithographed drawing of the church and esplanade, together with the Tower of David, has been published from the original of Mr. Habershon, the architect, a copy of which I have placed in the hands of the Committee.

Unless necessitated through want of funds, I do

not recommend the utilising of any portion of the Aqueduct of Herod, from the point near Rachael's Tomb, where it ceases to be tubular : as by adopting the merely channelled portion in *any* part, water could only be delivered about the level of the ground at the Jaffa Gate, as formerly ; and not at the highest point in the city. Moreover, as that portion lay upon or near the surface of the ground, it received serious injury, and has been in great measure removed ; so much so, that there would be but slight economy in electing to repair it. Another strong objection to doing so is, that lying on or near the surface, within reach of the agriculturists, it would be constantly liable to having dams placed in it, to cause the water to overflow for the irrigation of their fields.

An estimate of the expense of remodelling this aqueduct will be found, with others, in Chap. VI., Sec. 5.

The elevation of the Lowest Pool above the Jaffa Gate being 77 feet, and the distance nearly seven miles, or, with some unavoidable lateral flexures, perhaps fully seven miles (not considering the undulations of the ground, which cannot affect the question), the rate of inclination is about 11 feet per mile, or 1 in 480.

A 9-inch pipe with that inclination would discharge $49\frac{4}{10}$ cubic feet of water per minute, which amounts to 25,964,640 cubic feet per year; equal to 71,136 cubic feet, or 443,330 gallons per day; or nearly 22 gallons per day for each of the 20,330 present inhabitants of the city: being about the same quantity as each inhabitant of London enjoys, exclusive of manufactures, as shown by Table, Chap. I., Sec 2.

A 5-inch pipe with same inclination would discharge about $11\frac{1}{10}$ cubic feet per minute; which amounts to 5,834,160 cubic feet per year; equal to 15,984 cubic feet, or 99,614 gallons per day; or nearly 5 gallons per day for each of the present inhabitants.

I have purposely drawn up the following notes applicable to the three pools together, as it is easy to modify them to the capability of two, should it be determined on to give the Bethlehemites the use of the Third Pool; and upon ascertaining what exact proportion of the whole catchment area belongs specially to it.

The three pools conjointly, taking Dr. Robinson's measurements, and making ample allowance for irregularities and curvatures of the bottoms, contain about 8,044,826 cubic feet; which, if they were only

once filled in the year, would give 22,041 cubic feet, or 137,361 gallons per day ; *i. e.*, 2,210,666 cubic feet in the year more than a 5-inch pipe could convey.

Therefore, the 5-inch pipe should be determined on only in the event of sufficient funds not being procured to enable the laying down of a larger one.

The "drainage area" of the three pools together, being about five square miles (Chap. V., Sec. 2), it would, if properly laid out, yield nearly 340 millions of cubic feet of water in the year (Chap. II., Sec. 11), or about 42 times as much as the pools could contain ; which quantity, if distributed uniformly throughout the year, would equal $646\frac{4}{10}$ cubic feet per minute, and require a pipe more than 2 feet in diameter, with a fall of 11 feet in the mile, to discharge it.

Were sufficient money available, a cistern should be constructed in that part of the Tyropœon immediately outside the wall, to retain such portion of the rain-fall of the city as would otherwise escape. The water of this cistern, though unfit for household purposes, would be well worth preserving, and most valuable for the irrigation of the gardens upon Ophel, and along the southern base of Zion, to which it could be easily conducted by a superficial channel.

All the reservoirs within the walls should be roofed over, like the Cistern of the Thousand and One Columns at Constantinople, to preserve the water pure, to prevent vegetation occurring in it by the action of air and light, and to avoid loss by evaporation.

A keeper also should be appointed to attend constantly to the stanching of all the tanks, reservoirs, and cisterns, and to their thorough cleansing out once a-year, at the commencement of the rainy season—those belonging to private houses equally with those which might be public property.

To show that the water-works herein recommended as the *least* that would suffice are not of any great magnitude, I shall mention a few instances of what has been done in other places.

In Egypt there are remains of immense lakes and canals, which were constructed as reservoirs to store up the waters of the Nile in times of flood, for the irrigation of the land during the period of low water. And in many parts reservoirs were hollowed out of the solid rock at the tops of hills, to which water was raised by hydraulic machinery, and from which districts of barren land were watered and rendered fertile.

To Constantinople water is conveyed by aqueducts, about 12 miles in length, from reservoirs constructed by the Roman Emperors on the slopes of mountain ranges.

Along the coast of South America there are districts of 2,000 square miles in extent, upon which rain scarcely ever falls; yet these are rendered fertile by irrigation: and in one case the Peruvians have made an aqueduct, 450 miles in length, to irrigate an extensive tract of pasture land.

In Syria also the magnitude of the ancient aqueducts should not be overlooked—for instance, the two from Solomon's Pools to Jerusalem, already spoken of; those at Jericho, Tyre, Antioch, Hamath, Beirût, and St. Jean d'Acre.

SECTION 6.

PRACTICABILITY OF ESTABLISHING A PERMANENT CASCADE AND "BROOK" IN THE KIDRON.

The total amount of water capable of being procured for the city by ordinary means (not counting that which might be obtained from the rain-fall upon streets and unoccupied spaces within the walls), as

shown in Sec. 2 of this Chap., is 16,004,944 gallons, or 2,569,012 cubic feet per day ; from which, deducting 279,261 cubic feet per day, ascribed to the Lower Pool of Gihon, and 134,505 cubic feet per day, estimated as that due to wells in the vicinity, making together 413,766 cubic feet per day, we get 2,155,246 cubic feet per day, or 1,497 (nearly) cubic feet per minute ; sufficient to fill a pipe more than $3\frac{1}{4}$ feet in diameter, having a fall of 5 feet per mile.

If, say, one-fourth of this should be prevented running through the sewers, and after it had passed through the city in various pipes and channels, which might here converge, should be made to flow into a pond, like the Serpentine in Hyde Park, prepared for it, above the Garden of Gethsemane, a permanent cascade might be established from the embankment ; the flow of which, with a depth of 6 inches above the weir, would be nearly 5 feet in width, and become the source of a rivulet, or veritable "brook" in the Kidron, from 2 to 3 feet wide, according as the depth of the stream and the gradients of the ground might vary.

SECTION 7.

TABLES—

Showing the comparative capacities of various Reservoirs—Extent of Catchment Areas—Rain-fall—Per-centage of same flowing by Drainage from the Land—and other particulars.

By referring to the following Table No. 1, which I have been at some pains in drawing up, showing the relative capacities of the principal reservoirs at Jerusalem, as compared among themselves; and also the requisite capacities, calculated from the extent of their drainage areas, and the known depth of rain-fall, upon the principles laid down throughout the volume, and comparing it with Table No. 2, taken from the works of Mr. Neville, Mr. Beardmore, Mr. Hughes, and Mr. Homersham, in which are set down the ascertained results of rain-fall in our own country, which is much less than at Jerusalem, and in which are also set down both the actual and the relative capacities of reservoirs constructed to receive it, the reader may satisfy himself that I have in no one particular throughout the whole either underrated the efficiency of any of the ancient works, or over-esti-

mated the quantity of water which natural means have put it in our power *easily* to collect; though at first, without consideration, some of my statements may appear startling to those, on the one hand, who have not made the subject of hydrology a study, and, on the other, to those who may have imbibed a fanciful or poetical idea of the magnitude of any work attributed to Solomon, as is the case with many.

For instance, Mr. Lewin, who, in most other particulars, has written a very sensible work on Jerusalem, recently published by the Messrs. Longman, speaking of the Pool of Bethesda, and as proof that it was one of Solomon's constructions, gravely asserts that no other king could have had sufficient riches to make so great a reservoir!

To demonstrate the incorrectness of this conclusion, it need only be observed, that the Pool of Bethesda is very little more than twice as large in cubical capacity, and not so large in surface extension, as the ordinary covered service reservoir at Putney Heath, which contains ten millions of gallons; whilst, by referring to Table No. 2, it will be seen that it is quite insignificant, and that Solomon's Pools also (two of which are smaller) are quite insignificant as compared to some of our impounding reservoirs.

Take as example that of Rivington Pike, near Liverpool, which contains 481 millions of cubic feet; whereas the Pool of Bethesda contains only about $3\frac{1}{2}$ millions; and the largest of Solomon's Pools, near Bethlehem, accounts of which have likewise been greatly exaggerated, contains less than 4 millions of cubic feet. That is, in unpoetic language, the greatest of Solomon's reservoirs is less than 120 times, or, according to the precise figures, less than 124 times as small as one of our ordinary works, which took no fabulous amount of money to construct. As to the Pool of Bethesda, the building of many a lock of a canal, or small graving dock, cost more money. (See drawing of it in Bartlett's *Jerusal. Revis.*, p. 112.)

It will be seen from Table 1, that unless the reservoir outside the Damascus Gate were enlarged to more than 24 times the size of the Pool of Bethesda, or nearly 1,699 times its own present size, it could not contain 45 per cent. of one year's rain upon its small catchment area of $1\frac{1}{4}$ square mile; and that after having twice filled the Pool of Bethesda, Birket el-Hejjeh, and Birket Hamman Sitte Myriam, it should be enlarged to more than 11 times the size of the Pool of Bethesda, or to more than $812\frac{1}{2}$ times its own present size, to be capable of storing up for summer

use *one-half* the drainage from the land, or $22\frac{1}{2}$ per cent. of the rain-fall; and that, according to Homersham's estimate, in which he allows 24 thousand cubic feet of reservoir accommodation for each acre of drainage surface, the size of the reservoir should be $5\frac{1}{2}$ times greater than the Pool of Bethesda, or 386 times its own present capacity.

Moreover, Homersham's estimate, it must be remembered, was calculated to suit the requirements of a country where the depth of rain-fall was much less than at Jerusalem, and the periods of rain more evenly distributed throughout the year, each of which circumstance, in itself, proportionately reduces the dimensions requisite for the storage of the water.

It will also be interesting to compare the other tabulated results respecting the Damascus Gate Reservoir, Solomon's Pools, and the Upper Pool of Gihon.

T A B L E I.

Giving Particulars with reference to Size of Solomon's Pools and Reservoirs at Jerusalem ; respective Drainage or Catchment Areas ; Rain-fall ; proportion of same available by Drainage, &c. The First, Fifth, and Sixth Columns contain Information respecting the Reservoirs and their Drainage or Collecting Areas ; the Second, Third, and Fourth show the whole Rain-fall in the District, and the Depth and Per-centage flowing off the Land, and available ; the Seventh and Eighth show the number of times greater than at present each Reservoir should be to fulfil stated conditions, and also than the Pool of Bethesda, as a Standard of Comparison.

Names of Reservoirs.	PRESCRIBED CONDITIONS FOR WHICH THE DIMENSIONS ARE CALCULATED.	Extent of Drainage Area in Square Miles.	Depth of Rain-fall in Inches per Annum.	Depth of Rain in Inches per Annum flowing from the Land.	Per-cent. of Rain-fall per Annum flowing from the Land.	Reservoir accommodation per Sq. Mile, in Millions of Cubic Feet.	Total capacity of Reservoir in Millions of Cubic Feet.	Number of times as great as Present Capacity.	Number of times as great as Pool of Bethesda.
Solomon's Pools.	(To contain total Drainage of One Year	12	65	29·25	45	67·95	339·76	42·21	96·79
	After filling Great Cistern beneath Haram,* to contain total remaining Drainage of One Year.					67·88	339·44	42·22	96·71
	To contain One-Half Drainage of One Year.....					33·97	169·88	21·1	48·39
	After Twice filling Great Cistern beneath Haram, to contain One-Half remaining Drainage of One Year					33·91	169·56	21·09	48·31
	Requisite Capacity according to Homersham's Estimate of 24,000 Cubic Feet of Reservoir Accommodation to each Acre of Drainage Surface					15·36	76·8	9·55	21·88
	Present Capacity		31·25	12	38·4	1·61	8·04	1	2·29
			65	29·25	45				

* Capacities of the following Reservoirs in cubic feet, expressed in terms of a million as the unit : Great cistern beneath Haram, 0·32 : Pool of Bethesda, 3·51 ; Birket el-Hejjeh, 0·03 ; Birket Hamman Sitte Myrium, 0·13 ; Pool of Hezekiah, 0·35.

TABLE 1—Continued

Names of Reservoirs.	PRESCRIBED CONDITIONS FOR WHICH THE DIMENSIONS ARE CALCULATED.	Extent of Drainage Area in Square Miles.	Depth of Rain-fall in Inches per Annum.	Depth of Rain in Inches per Annum flowing from the Land.	Per-cent. of Rain-fall per Annum flowing from the Land.	Reservoir accommodation per Sq. Mile, in Millions of Cubic Feet.	Total Capacity of Reservoir in Millions of Cubic Feet.	Number of times as great as Present Capacity.	Number of times as great as Pool of Bethesda.
Dainassus Gate Reservoir.	To contain total Drainage of One Year.....	1.25.	65	29.25	45	67.95	84.94	1698.8	24.2
	After filling Pool of Bethesda, Birket el-Hejjeh, and Birket Hammam Sitte Myriam, * to contain total remaining Drainage of One Year.....					65.01	81.27	1625.4	23.15
	To contain One-Half Drainage of One Year.....					33.97	42.47	849.4	12.1
	After Twice filling Pool of Bethesda, Birket el-Hejjeh, and Birket Hammam Sitte Myriam, to contain One-Half remaining Drainage of One Year.....					31.04	38.8	776	11.05
	Requisite Capacity according to Homersham's Estimate (given above).....		31.25	12	38.4	15.36	19.2	384	5.47 less
Upper Pool of Gihon.	Present Capacity	1.25	65	29.25	45	0.04	0.05	1	70.2
	To contain total Drainage of One Year.....		65	29.25	45	67.95	152.89	128.48	43.56
	After filling Pool of Hezekiah, * to contain total remaining Drainage of One Year.....					67.79	152.54	128.18	43.46
	To contain One-Half Drainage of One Year.....					33.97	76.44	64.24	21.78
	After Twice filling Pool of Hezekiah, to contain One-Half remaining Drainage of One Year					33.82	76.09	64.94	21.67
	Requisite Capacity according to Homersham's Estimate (given above).....		31.25	12	38.4	15.36	34.56	29.04	9.7 less
Present Capacity			65	29.25	45	0.53	1.19	1	2.95

TABLE 2.

Giving Particulars with reference to Size of Reservoirs, Catchment Areas, &c., in Great Britain, Ireland, and America. The First, Fifth, and Sixth Columns contain Information with reference to Reservoirs, and their collecting Areas; the Second, Third, and Fourth, show the total Rain-fall for each District, and the Depth and Per-centage flowing off the Land, and available.

DRAINAGE AREAS AND NAMES OF RESERVOIRS.	Extent of Drainage Area in Square Miles.	Depth of Rain-fall in Inches per An- num.	Depth of Rain in Inches per An- num flowing from the Land.	Per-cent. of Rain- fall flowing from the Land.	Reservoir accom- modation per Sq. Mile, in Millions of Cubic Feet.	Total Capacity of Reservoir in Mil- lions of Cubic Feet.
Ashton	0.59	40	15.5	39	21	12
Albany Works, Unit. States.	29	...	...	...	1.1	32
Ballinrobe, Ireland.....	11	49.3	28.5	58	...	..
Belmont (moorland, mean of four years)	2.81	45.5	39.6	72	26.8	75
Bolton.....	0.8	...	...	...	25.6	20
Bute (low country) .....	...	45.4	23.9	53	...	...
Bann Reservoir, Ireland .....	...	72	48	66	...	...
Drainage Areas on South side of Longridge Fell, near Preston, May 1852 to April 1853 .....	...	...	15.5	29	...	...
	...	54	18	33	...	...
	...	...	22	43	...	...
Dilworth Reservoir of Pres- ton Works, Lancashire.....	0.09	...	...	...	54	5
Glencorse, for Edinburgh.....	6	37	22.3	60	7.66	46
Greenock.....	7.88	60	41	68	38	300
Longdendale, for Manchester	23.8	...	...	...	12.3	292
Bateman's Evidence on the Drainage Area of Longden- dale :—						
First half of 1845, very dry..	...	21.2	13.5	64	...	...
Second half of 1845 .....	...	38.6	27.25	71	...	...
First half of 1846.....	...	22.5	17.5	78	...	...
Oct., Nov., and Dec., 1846..	...	10.2	8.67	85	...	...
Rivington Pike, for Liverpool	16.25	55.5	24.25	44	29.6	481
Sheffield.....	1.42	...	...	...	36.5	52
Turton and Entwistle	3.18	46.2	41	89	31.43	100
Wolverhampton Works, pro- posed Reservoir	22.5	...	...	...	0.71	16

CHAPTER VI.

SECTION 1.

SEWERAGE OF THE CITY.

HAVING so far disposed of the question of the water supply, we now come to another subject which claims equal attention—namely, the sewerage of the city ; the cleansing of it from the filth of ages, which fosters fever, ague, and leprosy—causing a lack of energy in the people, accompanied, as indolence ever is, by poverty.

Placed as Jerusalem is on an eminence—with a considerable depression running from north to south through its centre, and a rapid fall thence, downward through the Valley of the Kidron, towards the Dead Sea—I know of no city which might be more easily, or at less expense, provided with an efficient system of sewers ; and the means are at hand also of flushing them with water.

The existing sewers, if such they can be called, act merely as cesspools and receptacles for filth. Too large and unequal in their dimensions to be capable of being cleared out by flushing, even if water were provided for that purpose. They are so ill-constructed, that it would appear they never were intended to carry off the sewage matter, but merely to contain it. The foul gases generated in them continually produce epidemics; and when, from time to time, openings are made in the streets, to clear them out by hand, when surcharged with matter, the smell becomes insupportable, and infectious diseases are engendered in the locality, and radiate to other quarters. One of these old sewers, or receptacles, runs in the depression from the Jaffa Gate towards the Tyropœon; and another in the depression from the Damascus Gate towards the Mucaribeh, or Moor's Gate, and has an outlet in the Tyropœon Valley, about 40 yards outside the wall; but there is no discharge of sewage matter from it, and it only serves to carry off part of the winter rain, which, being admitted in small quantities, gradually, as it falls, quietly flows over the surface of the consolidated matter, without disturbing, or being able to remove any before it. Even if it should remove

any, where could it deposit it? On the sloping side of the hill, exposed to the sun and wind, within forty yards of the city wall, at the edge of a public road, and overflowing two others immediately below it! The positions of all may be seen upon the Map. It was through this "gully" that the felaheens, or Arab peasants, in 1834, effected an entrance into the city, and admitted the troops of Ibrahim Pasha; there happened at the time to be an opening in the street near the Fountain of the Bath of Healing, through which they emerged. Till these enormous gullies are effectually cleansed, the filth removed far outside the precincts of the city, and the gullies stopped up—or, so far as they lie in the proper course, transformed into smaller sewers of suitable proportions, such as those specified in Sec. 5 of this Chap.—no sanitary improvement of any great magnitude can take place in the city.

SECTION 2.

SYSTEM OF SEWERS SUITABLE IN JERUSALEM.

The principal depression above noticed ranges from the Damascus Gate, on the north, towards the place proposed in Chap. V., Sec. 5, for the construction of a reservoir on the south, near the S.W. angle of the

Haram. A suitable sized sewer should be made through this, along the line of the present street leading through the Mohammedan and Jewish quarters. It might terminate at a convenient distance from the city, where the deposit might be utilised for agricultural purposes, as in China, parts of England, and other European countries; whereby two chief objects would be gained: employment given to the inhabitants, and increased fertility to the country. Some statistics on this head are given in Chap. VI., Sec. 4. Lateral minor sewers should be run from each side into the main duct, and one sub-main on the west side, along the depression commencing at the Jaffa Gate, and thus the arrangement would be in a measure complete. In the performance of this work, especially in the sinking of the main sewer, not far from the Cloisters of the Temple walls, in the "Valley of Slaughter," where cities lie on cities, and ruins over ruins—fifty feet, sixty feet in depth*—what relics of

* Josephus states that the Tyropœon was fifty cubits deep (Jewish Wars, Book V., Chap. v. 8.); that is, about seventy-five English feet. It is now greatly filled up. There were two cubits in use among the Jews; the old cubit was about 15 inches, the new one about 18. The Greek and Roman cubit was about 18 inches, or the length of a fore-arm, from the elbow to the extremity of the third finger; as used at present in the East.

the Jewish monarchy, what interesting antiquities might not be discovered!—perhaps priceless manuscripts, historical records, containing a fuller history of our race, of our Creator, or of the Jews, that wondrous nation, His chosen people.

The execution of this work would, I might almost say, infallibly lead to the discovery of one of the most important relics of the original Temple which we can now expect to find—the piers and foundations of the magnificent bridge which Solomon built across the Tyropœon, “his ascent by which he went up into the house of the Lord,” mentioned in 2 Chronicles ix. 4, and 1 Kings x. 5; which, together with “his house that he had built,” and other objects of splendour, caused such astonishment in the Queen of Sheba, “that there was no spirit in her, and she said to the king, It was a true report that I heard in mine own land of thine acts and of thy wisdom; howbeit I believed not their words, until I came and mine own eyes had seen it; and behold, the one half of the greatness of thy wisdom was not told me.”

For the discovery of the “springing” of the arch of the eastern abutment of this bridge we are indebted to Dr. Robinson; but the abutment itself, which

formed part of the Temple wall, is buried in the ground beneath the detritus and ruins of many Jerusalems. I have marked upon the Map the position of the bridge, restored. Its southern side was 39 feet from the S.W. corner of the Haram wall, and its breadth was 51 feet. Part of the first arch still remains, protruding from the wall. It consists of three courses of immense stones ; one stone being $24\frac{1}{2}$ feet in length, another $20\frac{1}{2}$, and measuring from a photograph which I procured when inspecting the locality, each of them is about 6 feet in height.

It may well be asked, Why were not these arch stones, which project in such a conspicuous manner, discovered long before Dr. Robinson's visit? The answer is simply this—From a distance their real nature is not easily discernible ; and, till lately, none but Moslems, true believers, were permitted, except under very peculiar circumstances, to approach the wall of “ the Noble Sanctuary,” for that is the meaning of the appellation el-Haram esh-Sherif, save at one spot, where the Jews, upon payment of a tribute, are, and have been for a number of years, allowed to draw near and kiss the stones of their ancient Temple, and mourn over its fall ; hence the name it bears, the Jews' Wailing Place. I have seen tears rolling

down the poor creatures' eyes, as they loudly and vehemently chanted their hymns; during the time shaking their bodies violently (for what purpose I cannot tell), and then pressing their lips and bosoms to the hallowed great stones in the wall. It painfully called to memory the words of the Psalmist, "Thy servants take pleasure in her stones, and favour the dust thereof" (Psalm cii. 14); and nothing more than a few stones and the very dust now remains to them.

The Bridge (*γέφυρα*) is often incidentally mentioned by Josephus. It was either upon this very abutment, or near it, that Titus, having captured the Temple, stood to hold a parley with the Jews in their last extremity, speaking to them across the Tyropœon—for they still retained possession of the "Upper City," or Modern Zion—and intreating of those that were left, to spare him the necessity of committing further carnage, by laying down their arms, and submission to his standard. I must own that I was never in my life so greatly affected with compassion and awe as when wandering over the foundations of that Tyropœon Bridge, amidst a jungle of gigantic cactus, overtopping my head, and within a stone's throw of the Jews' Wailing Place.

Oh, weep for those that weep
Whose shrines are desolate, whose land a dream ;
Weep for the harp of Judah's broken shell,
Mourn—

And when shall Israel lave her bleeding feet ?
And when shall Zion's songs again seem sweet ?
And Judah's melody once more rejoice
The hearts that leap'd before its heavenly voice ?

Tribes of the wandering foot and weary breast,
How shall ye flee away and be at rest !
The wild dove hath her nest, the fox his cave,
Mankind their country—Israel but the grave !

—*Hebrew Melodies.*

Since I left Jerusalem, and within the present year, the western abutment of this bridge, that against Mount Zion, has been discovered ; so I was informed by Dr. Barclay, but he had not, when I met him in London, heard particulars. It now remains for us to ascertain the depth of the Tyropœon, and bring to light the piers, of which there were probably six, judging from the segment of the arch that now remains, which, if a semicircle, would span about 41 feet ; and seven such arches, together with a reasonable breadth, say 11 feet for each of the six piers, would cross the valley, which is in that part 350 feet broad. Professor Porter says : “ Making allow-

ance for the breadth of the piers and the abutment on Zion, five such arches would be required to cross the Tyropœon." But it is not likely a portion of the valley was blocked up by a protruding abutment, and there would be no occasion whatsoever for stouter piers than those I mention, neither would they be ornamental.

SECTION 3.

MEANS OF FLUSHING THE SEWERS.

All the water of the cistern outside the Damascus Gate, as mentioned in Chap. V., Sec. 5, should be reserved for the flushing of the large central sewer. For the purpose of flushing such of the other sewers as should lie on too high a level to be commanded by any existing reservoir, two small tanks should be erected, one at each side of the central depression; the first on the elevated ground at the N.W. corner of the city, the other on the high point near Herod's Gate.

By using tramways, water might be cheaply drawn to these on carriages, by manual labour or draught cattle. And it cannot be questioned that water-carts, mounted on wheels, and drawn upon

tramways, would be a vast improvement on the present mode of conveyance in goatskins slung upon donkeys, or across men's shoulders.

SECTION 4.

UTILIZATION OF THE MANURE.

That the excrementitious matter removed from the city, where it has been injurious, should not be wasted, but turned to account, and rendered beneficial, is easily comprehended; but to what extent it might be rendered valuable is another question.

As I have all through endeavoured, step by step, to *prove* the grounds upon which I have founded my opinions, by adducing instances of fact, and, as far as possible, citing parallel cases, I shall now also, by quoting instances and analogous cases, endeavour to show the great benefit to the country which would result from a utilization of the sewage matter. If properly prepared and deodorised, it might be sold at a profit, and conveyed in panniers, upon asses' and camels' backs, to distant farms: thus, in a degree, rendering reproductive the outlay in the construction of the sewers.

Baron Liebig states, "When human excrements

are treated in a proper manner, so as to remove the moisture without permitting the escape of ammonia, they may be put into such a form as will allow them to be transported even to great distances."

The sewage of the city of Milan is collected in two concentric canals—the inner of which is called the Sevese, and the outer the Naviglio—and then poured into another canal, called the Vettabbia. Along its course large extents of meadow ground are irrigated, by the liquid from the sewage being permitted to flow over them; and the deposit, which must occasionally be removed to prevent the ground rising above irrigation level, possesses such valuable fertilising properties, that it is eagerly purchased as manure by the neighbouring agriculturists.

Some of the meadows irrigated by the sewage of Milan produce a net rent of £8 per acre, independent of taxes, and are mowed in January, March, April, and November, as fodder for cattle; besides which, they produce three crops of hay in the year; one in June, another in July, and the third in August; and in September they afford excellent pasture and grazing land, till the season for fresh irrigation, in winter, commences.

Mr. Smith, of Deanston, the celebrated agriculturist, in his report to "The Commissioners for Inquiring into the State of Large Towns and Populous Districts," upon the "Application of Sewer-water to the purposes of Agriculture," gives the following important description of the manner in which, for upwards of thirty years, the sewage-water of part of Edinburgh has been applied for the improvement of meadow and grass land:—

"The sewer-water coming from a section of the Old Town is discharged into a natural channel or brook at the base of the sloping site of the town, at sufficient height above a large tract of ground extending towards the sea to admit of its being flowed by gravitation over a surface of several hundred acres. The water as it comes from the sewers is received into ponds, where it is allowed to settle and deposit the gross and less buoyant matter, which is carried along by the water, whilst it flows on a steep descent. From these tanks or settling-ponds the sewer-water flows at the surface, at the opposite end to its entrance. The water so flowing off still holds in suspension a large quantity of light, flocculent matter, together with the more minute *débris* of the

various matters falling into the sewers, and chiefly of vegetable and animal origin.

“The water is made to flow over plats or plateaus of ground, formed of even surface, so that the water shall flow as evenly as possible over the whole, with various declinations, according to circumstances; and it is found in practice that the flow of water can easily be adjusted to suit the declination.

“The practical result of this application of sewer-water is, that land which let formerly for from 40s. to £6 per Scotch acre, is now let annually at from £30 to £40; and that poor sandy land on the sea shore, which might be worth 2s. 6d. per acre, lets at an annual rent of from £15 to £20. That which is nearest the city bringing the higher rent chiefly because it is near, and more accessible to the points where the grass is consumed; but also partly from the better natural quality of the land.

“The average value of the land, irrespective of the sewer-water application, may be taken at £3 per imperial acre, and the average rent of the irrigated land at £30, making a difference of £27; but £2 may be deducted as the cost of management, leaving £25 per acre of clear annual income due to the sewer-water.”

Mr. Smith calculates that 17,920 gallons of sewer-water, containing 5 cwt. of dissolved and suspended matter, are equal in fertilising power to $2\frac{1}{2}$ cwt. of guano, or 15 tons of farm-yard manure; and he estimates the relative expense of the three kinds of manure as applied to an acre of land, as under:—

Cost of Manuring One Acre of Land with	£	s.	d.
17,920 gallons of Sewer-Water	0	12	9
$2\frac{1}{2}$ cwt. of Guano, at 8s.	1	0	0
15 tons of Farm-yard Manure, at 4s. . . .	3	0	0

He also calculates that the relative economy will increase on the part of sewer-water manuring, in proportion to the quantity applied of each kind of manure, as under:—

Cost of Manuring One Acre of Land with	£	s.	d.
35,840 gallons of Sewer-Water	0	16	6
5 cwt. of Guano, at 8s.	2	0	0
30 tons of Farm-yard Manure, at 4s. . . .	6	0	0

The “Essay on Irrigated Meadows,” by Mr. G. Stephen, published in 1826, gives the following particulars: “Edinburgh has many advantages over many of her sister cities; and the large supply of excellent spring water is one of the greatest blessings to her inhabitants, both in respect to household

purposes and in keeping the streets clean ; and, lastly, in irrigating the extensive meadows, selected below the town, by the rich stuff which it carries along in a state of semi-solution—where the art of man, with the common shore-water, has made sand hillocks produce riches far superior to anything of the kind in the kingdom, or in any country.

“By this water, about 150 acres of grass-land, laid into catch-water beds, is irrigated, whereof upwards of 100 belong to W. H. Miller, Esq., of Craigin-tinny, and the remainder to the Earls of Haddington and Moray, the heirs of the late Sir James Montgomery, and some small patches to other proprietors. The meadows belonging to the last mentioned nobleman, and part of the Craigintinny meadows, or what are called the old meadows, containing about 50 acres, having been irrigated for nearly a century, they are by far the most valuable, on account of the long and continual accumulation of rich sediment left by the water ; indeed, the water is so very rich, that the proprietors of the meadows lying nearest to the town have found it advisable to carry the common shore through deep ponds, where the water deposits part of the superfluous manure before it is carried over the ground.

“Although the formation is irregular, and the management very imperfect, the effect of the water is astonishing: they produce crops of grass not to be equalled, being cut from four to six times a-year, and given green to milk-cows. The grass is let every year by public auction in small patches, from a quarter of an acre and upwards, which generally brings from £24 to £30 per acre. This year (1826) part of the Earl of Moray’s meadow gave as high as £57 per acre.”

According to Mr. G. Drysdale Dempsey, C.E., author of “The Practical Railway Engineer,” at Ashburton, in Devonshire, liquid manure has been applied to land for more than 50 years; the original value was from 30s. to 40s. per acre, whilst its present value is from £8 to £12 per acre, and it produces grass a month earlier than any other land in the neighbourhood.

The Duke of Portland has applied the sewer-water of Mansfield, in Nottinghamshire, to a part of his property, and has thereby increased the value from 4s. 6d. to £14 per acre, the preliminary expenses being £30 per acre.

The following experiments, made by Mr. Thompson, at Clitheroe, in Lancashire, prove that the

fertilizing properties of sewer-water is about four times as great as that of farm-yard manure. He tried 8 tons of sewer-water upon one acre, and 15 tons of ordinary farm-yard manure upon another; and the produce of the former to the latter was in the proportion of 1·875 to 1; or comparing the produce of each with the *weight* of the manure, the proportion stands thus: 1·875 of the former to ·532 of the latter; or nearly four to one.

SECTION 5.

ESTIMATES OF EXPENSE.

On account of the favourable position of the line of streets in Jerusalem, along which it is recommended running the main sewer (the ground on each side rapidly sloping down to it), it would be unnecessary to sink it much below the surface; and therefore, on the point of economy, this work would be unprecedented by any city main sewer with which I am acquainted.

A sufficiently large and serviceable sewer, of which the dimensions are given in the sequel, might be executed at the following estimate:—

ESTIMATE FOR MAIN SEWER.

	£	s.	d.
600 yards of egg-shaped sewer, 2 ft. 8 in. high by 2 ft. wide ; from a point 70 yards south of the Damascus Gate, along the street through the Mohammedan quarter, to the intersection of David Street, at 10s. 6d. per lineal yard	315	0	0
275 yards, 3 ft. 3 in. high by 2 ft. 6 in. wide ; from the intersection of David Street to the Mucaribeh, or Moor's Gate, in the City wall, near the S.W. corner of the Haram, at 14s. 6d. per lineal yard	201	17	6
450 yards, 2 ft. 8 in. high by 2 ft. wide ; from the Mucaribeh Gate to the bottom of the declivity near the Pool of Siloam, at 10s. 6d. per lineal yard	236	5	0
200 yards, 3 ft. 3 in. high by 2 ft. 6 in. wide ; from foot of the declivity to a point near the King's Gardens, at 14s. 6d. per lineal yard	145	0	0
	<hr/>		
	£898	2	6

Should funds be obtained to complete the sewerage of the city, an egg-shaped branch sewer, or "sub-

main," should be constructed, from near the Jaffa Gate along David Street. To make preparation for which, at the intersection of David Street with the present proposed sewer, I have increased its dimensions, as may be observed in the estimate, and again reduced it to its original size, from the city wall to the foot of the declivity—for this reason: the sewage-matter would be conveyed more rapidly down that steep slope than upon more level ground; and consequently a sewer of less capacity there would in a given time carry off a quantity equal to that which one of greater capacity would convey on a less inclined surface.

When it attains the more level ground at the foot of the declivity, the size of the sewer is again increased, till it terminates in the vicinity of the King's Gardens; where either a public cesspool should be formed, or, as recommended in Sec. 2 of this Chap., the deposit utilised for the purposes of agriculture, whereby the King's Gardens and lands adjacent might be rendered more productive than the fields of Milan, or the meadows of Edinburgh.

By contracting the sewer in the reach of 450 yards down the declivity, a saving of £37 10s. has been effected in the estimate.

The repairs and a considerable enlargement of the cistern outside the Damascus Gate, and connecting it with the main sewer inside, might be effected for about £230 ; this does not include the expense of roofing, which is not absolutely essential, and is of secondary importance to a still further enlargement, which might be done at any other time, should money become available for that purpose.

As before mentioned (Chap. V., Sec. 2), about $1\frac{1}{4}$ square miles, or 800 acres, constitutes the area which might be brought to contribute its drainage to this cistern. Allowing on an average to each acre 24 lineal perches of drains, at 5d. per perch, the cost would be 10s. per acre, or altogether £400 for the means of supplying this cistern with water, together with the Pool of Bethesda, Birket el-Hejjeh, Birket Hammam Sitte Myriam, and the cistern, which, if money were available, should be constructed *inside* the gate, as recommended in Chap. V., Sec. 2.

The surface which might be made to contribute to the Pool of Hezekiah, through the medium of the Upper Pool of Gihon, equals about $2\frac{1}{4}$ square miles, or 1,440 acres; the expense of preparing which, to supply the pool with water, upon a similar calculation, would be £720.

These estimates together make £2,248 2s. 6d.; leaving £751 17s. 6d. of the funds at present available, which would be more than sufficient for the repairs of the present aqueduct from Solomon's Pools to Jerusalem; that is the first-mentioned aqueduct in Chap. II., Sec. 11, the construction of which is ascribed to Solomon, as distinguished from the second one, or that ascribed to Herod.

The remodelling of Herod's Aqueduct would be a far more beneficial work, and more in accordance with the progressive spirit of our age. (See Chap. V., Sec. 5.) I have therefore drawn up the following estimates with regard to it: they are given as alternatives.

The first, in the event that it shall not be found expedient to utilise any portion of the present stone tubing, and that sufficient funds shall be procured, together with the balance of £751 17s. 6d. above mentioned as available, to carry out the work in the most efficient manner.

The second, in the event of the same contingency with respect to the stone tubing, and that sufficient funds shall not be procured to carry out the work on a larger scale with iron tubing: in which case I propose either to use a smaller iron tube, or to substitute for it

stoneware tubing, of the best description, such as that manufactured at Glasgow of fire-clay: the cost of a pipe nine inches in diameter of fire-clay stoneware, and one of five inches in diameter of iron, being about the same, as shown by the prices charged at Glasgow for the former, and lately paid at Tottenham for the latter.

The third estimate is drawn up in the event that part of the stone tubing should be utilised, and that sufficient funds shall be procured to reconstruct the remainder of the aqueduct in the best manner with iron tubing.

The fourth, in the same case as to the utilising of part of the stone tubing, but that sufficient funds shall not be obtained to complete the work with an iron tube of the most approved diameter.

As shown in Chap. II., Sec. 11, it is probable that for about three miles and a quarter, or nearly one-half the total length of the aqueduct, the stone tubing is in a perfect state, but in a great part concealed beneath the *débris* of the hills; yet, while admitting the probability of this, for the sake of further security, I have in the estimates assumed that the stone tubing may at best be made available for only one-third of the required length.

ALTERNATIVE ESTIMATES FOR REMODELLING HEROD'S AQUEDUCT
FROM THE POOLS OF SOLOMON TO JERUSALEM.

ESTIMATE 1.

	£	s.	d.
11,330 lineal yards of nine-inch iron tubing, from a receptacle* at a suitable point N.E. of the Pools of Solomon to top of Tower of David, at 9s. 6d.	5,381	15	0
Laying same (to foot of Tower, two feet beneath surface of ground), stanching joints, replac- ing earth, &c., at 1s. 6d. per yard.	849	15	0
	<hr/> £6,231 10 0		

ESTIMATE 2.

11,330 lineal yards of five-inch iron, or nine-inch fire-clay stoneware tubing, from a receptacle* at a suitable point N.E. of the Pools of Solomon to top of Tower of David, at 6s.	3,399	0	0
Laying same (to foot of Tower, two feet beneath surface of ground), stanching joints, replac- ing earth, &c., at 1s. 3d. per yard	708	2	6
	<hr/> £4,107 2 6		

* The object of this receptacle, which should not be on a much lower level than the Second Pool, from which it should be supplied by a drain, leaving the Third Pool for the use of Bethlehem (see Chap. V., Sec. 5), is to preserve a uniform flow of water in the tube, under a constant head. The cost of the drain and receptacle, executed in a superior manner, would be about £160; but as a channel, &c., which would answer tolerably well, might be made without any very appreciable expense, I have not mentioned it in the body of the work, as I have moreover recommended that "minute surveys" should be undertaken preparatory to the carrying out of the projects. (See Preface.)

ESTIMATE 3.

Expense of nine-inch iron pipe, as above, for two-thirds of the distance, utilising the present stone tubing for the remainder £4,154 6 8

ESTIMATE 4.

Expense of a five-inch iron, or a nine-inch fire-clay stoneware tubing, as above, for two-thirds of the distance, utilising the present stone tubing for the remainder £2,738 1 8

SUMMARY OF ESTIMATES FOR PRESENT PROPOSED WORKS,
ADOPTING ESTIMATE No. 1 FOR THE AQUEDUCT FROM
SOLOMON'S POOLS.

	£	s.	d.
Construction of Main Sewer	898	2	6
Repairs and Enlargement of Cistern outside Damascus Gate	230	0	0
Formation of Drains for supply of same Pool of Bethesda, Birket el-Hejjeh, and Birket Hammam Sitte Myriam	400	0	0
Ditto for supply of Upper Pool of Gihon and Pool of Hezekiah	720	0	0
Remodelling of Herod's Aqueduct from Solomon's Pools, as per Estimate No. 1.	6,231	10	0
Total of Estimates	£8,479	12	6

OR, ADOPTING ALTERNATIVE ESTIMATE No. 2 (INSTEAD OF No. 1) FOR AQUEDUCT FROM SOLOMON'S POOLS—Total of Estimates £6,355 5 0

ADOPTING ALTERNATIVE ESTIMATE No. 3 FOR
 AQUEDUCT FROM SOLOMON'S POOLS—Total
 of Estimates £6,402 9 2

ADOPTING ALTERNATIVE ESTIMATE No. 4 FOR
 AQUEDUCT FROM SOLOMON'S POOLS—Total of
 Estimates £4,986 4 2

These, including the renovation of either of the aqueducts, are *essential* works, and complete in themselves, and even if every sympathy with the Holy City were to end here, and though no further improvements should be ever effected, they alone would constitute a great and a permanent blessing.

Whether it shall fall to our happy lot to see perfected the regeneration of Jerusalem, or whether that is reserved for our successors and another generation, it shall be surely accomplished; and we are the honoured instruments of initiating this great work, of giving the movement its first impetus, of pointing out the path, of laying the first stone: as David conceived the design and brought together the materials for the Temple, and left to his son the completion of it. Therefore, let us give liberally, according to our means, for the carrying out of the work which it would appear the Lord hath chosen us to do. These are the predictions of the Lord himself regarding it,

spoken in His own great name, by the mouth of his prophet Isaiah :—

“ For Zion’s sake will I not hold my peace, and for Jerusalem’s sake I will not rest, until the righteousness thereof go forth as brightness, and the salvation thereof as a lamp that burneth. And the Gentiles shall see thy righteousness, and all kings thy glory ; and thou shalt be called by a new name, which the mouth of the Lord shall name. Thou shalt also be a crown of glory in the hand of the Lord, and a royal diadem in the hand of thy God. Thou shalt no more be termed Forsaken ; neither shall thy land any more be termed Desolate ; but thou shalt be called Hephzi-bah [that is, ‘ my delight is in her’], and thy land Beulah [that is, ‘ married ’]: for the Lord delighteth in thee, and thy land shall be married.

“ For as a young man marrieth a virgin, so shall thy sons marry thee ; and as the bridegroom rejoiceth over the bride, so shall thy God rejoice over thee. I have set watchmen upon thy walls, O Jerusalem, which shall never hold their peace day nor night : ye that make mention of the Lord keep not silence, and give him no rest till he establish, and till he make Jerusalem a praise in the earth. The Lord hath sworn by his right hand, and by the arm of his

strength, Surely, I will no more give thy corn to be meat for thine enemies ; and the sons of the stranger shall not drink thy wine, for the which thou hast laboured : but they that have gathered it shall eat it, and praise the Lord ; and they that have brought it together shall drink it in the courts of my holiness.

“ Go through, go through the gates ; prepare ye the way of the people ; cast up, cast up the highway ; gather out the stones ; lift up a standard for the people. Behold, the Lord hath proclaimed unto the end of the world, Say ye to the daughter of Zion, Behold, thy salvation cometh ; behold, his reward is with him, and his work before him. And they shall call them the holy people, the redeemed of the Lord ; and thou shalt be called, SOUGHT OUT ; A CITY NOT FORSAKEN.” (Isaiah lxii.)

APPENDIX.

No. I.

*Note to Chap. I., Sec. 3.*POPULATIONS AND COMPARATIVE AREAS OF CITIES
IN VARIOUS CLIMATES.

Chorlton-on-Medlock, one of the townships in the borough of Manchester, contains 700 acres, with a population of 29,000, not quite equal to $41\frac{1}{2}$ persons per acre ; the number of houses in 1841 was 6,021, or about $8\frac{1}{2}$ to an acre, or more than $116\frac{1}{2}$ square yards for each individual : and this is about the average for English towns.

Preston comprised, in 1841, 1,960 acres, and a population of 50,131 ; and contained 9,994 houses ; which gives less than 26 persons to an acre, about 5 houses to an acre, and rather more than 5 persons to each house.

The following particulars are given by Mr. Fergusson, the distinguished architect:—

“ Liverpool, the most uniformly crowded town in England, according to a parliamentary return in 1842, gave 34 square yards to each person. Hamburg, a walled city, and one of the most crowded on the Continent, contains a population of 120,000, and gives 27 square yards to each. Benares, the most populous town in India, because devotees crowd within its sacred inclosure, contains, according to Mr. Prinsep’s survey, nearly 43 square yards for each individual. Calcutta, omitting the Esplanade and large open spaces, affords 70 square yards to each. Cairo, according to the French Government surveys, occupies about 9,600,000 square yards; and Volney, and, more recently, Sir Gardner Wilkinson, have estimated the number of its inhabitants at about 200,000, which allows 48 square yards to each.”

APPENDIX, No. II.

Note to Chap. II., Sec. 5.

AIN HAMMAM ESH-SHEFA—FOUNTAIN OF THE
BATH OF HEALING.

From Dr. Barclay's "City of the Great King."

"The entrance to this mysterious well is situated 10 feet south of the Cotton Bazaar, $125\frac{1}{2}$ feet from the Haram wall, and 176 from the Valley Street. Its apparent depth is nearly 85 feet; but subtracting $18\frac{1}{2}$ of this for the height of the house, upon the top of which the mouth opens, its real depth beneath the surface of the ground is only $66\frac{1}{2}$ feet. Its mouth being 10 feet higher than the general level of the Haram area, its bottom is, therefore, 75 feet below the level of the Haram.

"The following extract, from the pen of the accomplished Williams (Holy City, II. 457), will serve to evince the interest felt in this mysterious *Zemzam*, and entertain the reader by recounting an amusing adventure:—

" "The next fountain which I shall mention is one

within the city, near the area of the Great Mosk, known only by report until very lately, when an enterprising traveller undertook to explore it; and the company to whom he related his adventure, in the small shed built over the mouth of the well by which he effected his perilous descent, will not easily forget the thrilling sensations which his narration produced.

“ ‘ This fountain now supplies the Bath of Healing (Hamman esh-Shefa), which is entered from the ruined Cotton Mart. The present mouth of the well is on the roof of the buildings attached to the bath, and is found to be about 20 feet above the level of the street. Dr. Robinson had in vain sought permission to explore this well, but the reports which he had heard of it excited the curiosity of a countryman of his who was at Jerusalem in the winter of 1841—2, and he resolved, at all events, to descend. Having endeavoured, without success, to induce the keeper of the bath to aid him in the undertaking, he prevailed on two peasants of a neighbouring village to assist him. This was in the month of January. At the dead of night, attended only by a servant lad, and furnished with candles and matches, measuring-rule moreover, and a compass, forth he sallied, equipped as for an aquatic excursion.

“Arrived at the well’s mouth, he tied a cord round his body, and was lowered through the aperture by these *felláhs*, who had kept their appointment, but would, without doubt, have let the rope slip, and left their employer to his fate, on the slightest alarm. However, he survived to tell the tale; an outline of which shall here be given.

“The entrance to the well is not quite 2 feet square, but a few feet lower down it expands, and becomes about 12 feet square, and is apparently hewn in the rock. His first adventure in this aërial journey was meeting the leathern bucket which had been tied at the other end of the rope as a counterpoise. It was “streaming at a dozen apertures, and for the rest of the way he was under a cold shower-bath, and could with difficulty keep his light without the circle of it.” The well was $82\frac{1}{2}$ feet deep, and the water about $4\frac{1}{2}$. On arriving at the bottom, the vibrations of the rope, before he could get a footing, extinguished his light, and he was left in total darkness. He had observed, in his descent, four arched recesses in the rock, facing one another, and lower down, 6 feet above the water, a doorway leading into an arched chamber, which he contrived to reach, and here he refitted for his further voyage. The matches were dry, and other candles

soon illuminated the darkness. The excavated chamber in which he found himself was only 3 or 4 feet in height, 15 long by 10 broad, and did not seem to be constructed with any reference to the water. Opposite to this chamber he discovered a passage which formed the water-channel. He had taken the precaution of bringing with him an india-rubber life-preserver, which he found useful in his further explorations. He now descended into the water ; and, entering the passage, soon passed another excavation in the rock, of which he could make nothing. The passage beyond this was 2 or 3 feet wide, and about 5 feet high, covered with stones laid transversely, but very irregularly ; in some places were fragments of polished marble shafts, and in one place the end of a granite column had sunk obliquely into the passage. The bottom of the channel was not flat, but grooved ; the passage not straight, though its general course was direct ; and "the cutting so uneven as to suggest the thought that advantage might have been taken of a natural seam or fissure in the rock."

"Having followed this passage 80 feet, he was stopped by a basin or well of unknown depth, on the opposite side of which the wall shut down to the water,

and presented another obstacle, even could the water have been passed. Unhappily, he was obliged to return without any more satisfactory result. His exit is amusingly characteristic of cool intrepidity. He had barely breathing room, or space for his candle between the surface of the water and the roof of the passage; and one would think must have felt rather uncomfortable in such a position; but he first measured the passage with his rule, then illuminated it with his spare candles, and having taken a last fond look, left them burning there, and returned to the well to prepare for his ascent. The rope was still there, and the natives above. The signal was given, and he again found himself swinging in mid-air, and in darkness; the candle which he had reserved having been extinguished as before. "His descent had been uniform, but he was necessarily drawn up at intervals, which caused a greater vibration. He spun around the dark vault, striking against one side and another," and was not sorry to find himself again "beneath the open heaven." It is deeply to be regretted that this daring exploit was not attended with better success. Its results are very unsatisfactory to Mr. Wolcott himself. He does not imagine that this excavation was originally a well: the artificial recesses and

chambers in the rock he thinks are against it. It more nearly resembles some of the sepulchral excavations without the city. The direction of the passage he cannot positively determine, as he had injured his compass in the descent. He thinks it runs eastward in the direction of the Haram; but if so, it stops short of the enclosure 44 feet. The passage may extend further, the water descending into a lower gallery; if so, it could only be explored when the water is very low. Two English travellers were anxious to attempt this at the end of a dry summer, but no one could be prevailed on to aid the undertaking, and it was abandoned. At that time it was necessary for a man to descend to the well in order to bring the water from a distance to supply the bath, as the floor of the chamber was dry. A close cross-examination of this man elicited that the water proceeded from an immense reservoir beneath the Haram, but it did not appear that he had penetrated so far. It must be remarked that the water is identical in taste with that of Siloam.'

"Marvellous tales being still reported by the wonder-exciting Mohammedans concerning the wondrous subterraneous apartments yet unexplored, and startling theories based upon them, I felt no little

desire to examine for myself, and complete Mr. Wolcott's exploration. Accordingly, having obtained consent of its proprietor, and that, too, without backshish and without stipulation (a fact so unprecedented in the ways and doings of the Turks, that it could but be interpreted most favourably), I hired and spliced together two rope ladders, bought a new cord, and made all suitable arrangements for a descent; and, accompanied by our Dragoman and one of my sons, with a Silwan fellah, well acquainted with the place, as cicerone, I accomplished the descent of this wonder-exciting well on the 19th of November, 1853, being fully equipped with lights, measuring-line, compass, &c., and spent an hour or two in the exploration of its mysterious waters.

"Descending 10 feet through the small four-sided funnel, not quite 2 feet square at top, and becoming still smaller at its lower end, the shaft was found gradually expanding in size, and soon becoming cylindrical. At a depth of 28 feet are four small doorways, facing the cardinal points of the compass, and apparently shallow recesses behind them. The shaft enlarges to the size of 10 or 12 feet about midway, and again becomes square; but a few yards before reaching the bottom it diminishes again, and

terminates in a basin 8 feet square, covered with loose stones and gravel. At 11 feet from the bottom, in the north side of the well, is a doorway 4 feet thick, leading to a vaulted room 18 feet long and 14 wide. A passage rather circumscribed, varying in width from $1\frac{1}{2}$ to several feet, leads from the south side of the well, which is mostly an artificial wall 9 feet high, the passage being about 10 or 12 feet wider here than elsewhere; and for 15 or 20 feet arched over with rocks, apparently 2 feet by 1, and of very good workmanship. Only half of the vault is seen in its longitudinal extent, the remainder being apparently concealed by later additions of masonry, though as these half-arches are very common in the east, the other half may probably never have been constructed. At the end of this archway, about 24 feet from the well, the passage is reduced in height to about 6 feet, and for 8 or 10 feet is overlaid by coarse slabs of marble, a foot wide and half a foot in thickness, at a point 39 feet from the commencement—the course which the passage thus far has run—south 5° east, turns south 20° west, for 8 feet, and is ceiled with 11 small white marble pillars, and one large one of coarser material, one end of which is partly fallen through—the last-mentioned 20 inches, and the former

only 7 in diameter. The passage now leads, with slight variations of width, height, and direction, due south 35 feet, where the flow of the water is interrupted by a rock, equal in length to the width of the passage, and about a foot in height, or rather in thickness, cemented across it transversely, serving as an occasional dam. Thus far the passage gradually ascends (perhaps only half a foot in all), but now it suddenly deepens 3 feet, and continues that depth with an increased width as far as it could be measured, which, however, was only $14\frac{1}{2}$ feet. The ceiling of the passage, which, as far as this reservoir, is nowhere less than 4 or 5 feet, here gradually declines till it comes in contact with the water, thus effectually arresting all further progress, greatly to our disappointment.

“The bottom of the passage from this reservoir to the well whence the water is drawn up is not flat, but concave, and has a small channel a few inches deep, cut, perhaps, not by the hard chisel, but by the soft waters; for, in the lapse of ages, ‘waters wear the stones.’

“About 20 feet south of the well is a rough, irregular cave, a few yards in extent, on the east side, the mouth of which is about 6 or 8 feet above

the channel. There is also a square opening in the ceiling of the passage, a few yards farther south, leading to a small cave above. Various other small openings are also observable, both in the lining wall and the native rock, communicating with fissures and small caves. The total length of the channel of water, as far as measured, is $104\frac{1}{2}$ feet; but the guide, who has often been down when the water was at a low stage, to empty it from the southern reservoir into the channel conveying it to the well, assured me that it extends at least 100 feet farther in the same direction; but the low narrow passage can only be traversed when it is nearly exhausted of water. Although the native rock is visible at many places, for many yards in extent, yet most of the passage and the shaft is cased with masonry, of very inferior kind, though the room north of the well is hewn out of solid rock, which continues visible several yards above it. It was found impracticable to effect a landing in the small recesses indicated by the doors observed 50 or 60 feet above the water, though they appeared to be merely ornamental, and may have been in full view at the former level of the city. Touching the 'large arched room, supported by 14 marble columns with capitals,' the report of which is even credited

by the tradition-hating authors of the 'Biblical Researches,'* I have to report that it was not only '*non-come-at-able*,' but '*non inventus erat*.'

"The conclusions to which I had been necessarily brought by investigation elsewhere, in relation to the most interesting matter connected with the subject, were fully confirmed by this exploration, though materially different from any heretofore expressed, and are certainly justified by the facts of the case. Even had I not proved, by previous analysis, the fallacy of the assertion that this water is identical with that of the Virgin's Fount, Flagellation Well, Cotton Grotto reservoir, &c., this examination would have induced a contrary conviction; for instead of coming from the north, as such an opinion necessarily implies, the source of this fountain is directly from the south, and therefore cannot be derived from either of the above-mentioned places. And having witnessed an unusually copious outflow of the Virgin's Fount, of 37 minutes' continuance, on the preceding Friday, about mid-day, after 700 or 800 skins (4,000 or 5,000 gallons) had been drawn up for the bath, and its supply well nigh exhausted, I was convinced

* Bib. Res. I. 508.

that the outflow could not be owing, as is generally supposed, to the discharge of this alleged over-filled reservoir, by a rude kind of natural syphon. That it is not derived from a large fountain within the precincts of the Haram, esh-Sherif, as others contend, is also fairly inferable from the fact that the channel along which it flows, instead of coming from the east, in the direction of the Haram, approaches the well from the south, as far as is ascertained either by report or actual examination ; so that, when protracted, it falls considerably short of even touching the most westerly corner of the Haram enclosure.

“But that its source is entirely independent of, and totally disconnected with, any of the waters alluded to, or, indeed, any others whatever, is obvious from the fact (at least when considered in connexion with their small supply), that no such source is discoverable, and that water trickles into it from nearly every portion of the interior ; and though only *guttatim*, yet, considering the large surface from which it exudes, is fully adequate to the daily demand, which is only about 300 or 400 skinsful, except on Friday. Upon this Sabbatical day of the Moslem, about 800 skins are demanded for expurgatorial ablution. My own impression is, that a well (pro-

bably from former indications of moisture in the neighbourhood) was originally sunk to the depth of the room, now 10 feet above the bottom; which, being plastered and shaped as cisterns generally are, was probably the original cistern, and long used as the receptacle. But the supply proving inadequate to the demands of later times, after the cessation of the latter rains, it was deepened and enlarged; in process of which—following, no doubt, the leaky veins of porous, chalky formation—a cave of crumbling material was reached, which required to be walled in and supported by masonry. Does not the profuse use of broken marble pillars for such common purposes indicate that this enlargement was subsequent to one of Jerusalem's sad overthrows—perhaps after the return from Babylon? The smaller ones, perhaps, may once have adorned a little Temple over the well! Although there was not as much to be seen in these nether regions as was reported, yet, inasmuch as I was enabled to clear up some difficulties connected with an interesting subject—at least, to my own satisfaction—I was highly gratified with this Plutonic excursion; but right glad was I to regain the surface of the earth once more in safety, for I could but be most feelingly impressed by the perilous

position in which I found myself on the sudden snapping of one of the slender ropes of the ladder, when, even despite the cord fortunately tied around my body by way of security, the brittle thread of life had well-nigh been severed.

“The fond tenacity with which many persons cling to the idea that this well is in connexion with an inexhaustible fountain under the threshold of the ancient Temple, is truly astonishing. In a late and interesting, but highly-speculative, work on the Holy Land, by Captain Allen, of the Royal Navy, he remarks in relation to the account of my exploration given by Mr. Bartlett (‘Jerusalem Revisited’ *): ‘Dr. Barclay succeeded in examining this (Hammam esh-Shefa), and says “the theory which ascribes its supply of water to reservoirs under the Haram, is entirely disproved by the exploration.” I am not disposed fully to agree with this, although the hypothesis of the long passage being intended for the purpose of increasing the “guttation,” is very plausible; yet he did not, as it appears, reach the end of the passage, where alone the mystery is to be solved.’

* Page 87 of this very interesting and admirably illustrated work—the last production of this gifted author and artist.

“Most evident is it, however, from what has been already stated, that this well does not communicate with any source of living water of the Haram, and more especially with one immediately under the threshold of the Holy Oracle. Nor can it be in connexion with any of the Haram reservoirs—for it is 33 feet lower than the large reservoir between Kubbet es-Sakhrah and el-Aksa; 42 lower than that between the well and the supposed site of the Temple, and 28 below that in el-Aksa, the most southern and the deepest reservoir in the Haram enclosure.”

APPENDIX, No. III.

Note to Chap. II., Sec. 7.

TUNNELLED CONDUIT FROM THE FOUNTAIN OF THE
VIRGIN TO THE POOL OF SILOAM, &c.

The following, which embodies Dr. Robinson's own words, is taken from the work of Professor Porter :—

“One of the most remarkable circumstances connected with the Fountain of the Virgin is the *irregular flow of the water*, long known by the inhabitants, and witnessed by Dr. Robinson. His account of it is highly interesting: ‘As we were preparing to measure the basin of the fountain, and explore the passage leading from it, my companion was standing on the lower step near the water, with one foot on the step and another on a loose stone lying in the basin. All at once he perceived the water coming into his shoe; and supposing the stone had rolled, he withdrew his foot to the step, which, however, was also now covered with water. This instantly

excited our curiosity ; and we perceived the water rapidly bubbling up from under the lower step. In less than five minutes it had risen in the basin nearly or quite a foot ; and we could hear it gurgling off through the interior passage. In ten minutes more it had ceased to flow ; and the water in the basin was again reduced to its former level. Meanwhile, a woman of Kefr Silwân came to wash at the fountain. She was accustomed to frequent the place every day ; and from her we learned that the flowing of the water occurs at irregular intervals ; sometimes two or three times a day, and sometimes in summer once in two or three days. She said she had seen the fountain dry, and men and flocks dependent upon it gathered around, and suffering from thirst ; when all at once the water would begin to boil up from under the steps, and from the bottom in the interior part, and flow off in a copious stream.'

"At the upper end of the Pool of Siloam is an arched entrance to a ruinous staircase, by which we descend to the mouth of the conduit that comes from the Fountain of the Virgin. Dr. Robinson, having heard it currently reported in Jerusalem that Siloam was united by a subterranean passage to the Fountain of the Virgin, determined to explore it. Entering

at the staircase above mentioned, he found the passage cut through the rock, 2 feet wide, and gradually decreasing from 15 to 3 feet in height. At the end of 800 feet it became so low that he could advance no farther without 'crawling on all fours.' Here he turned back; but coming better prepared for an aquatic excursion on another day, he entered from the Fountain of the Virgin. Here the difficulties proved still greater. 'Most of the way we could indeed advance upon hands and knees; yet in several places we could only get forward by lying at full length and dragging ourselves along upon our elbows.' This shows the nature of the passage, and the immense labour the excavation must have cost. He succeeded at length in working his way through. The channel winds and zigzags, in the very heart of the rock, so much that, while the direct distance is only 1,100 feet, the passage measured 1,750. The discovery of this remarkable conduit explains at once why Siloam has been also regarded as a *remitting* fountain. Jerome appears to be the first who noticed this peculiarity; he is at least the first who records it. He says, 'Siloam is a fountain whose waters do not flow regularly, but on certain days and hours; and issue with a great noise from caverns in the rock.'

APPENDIX, No. IV.

Note to Chap. III., Sec. 1.

ARGUMENT, AND TEXTS OF SCRIPTURE, &c., UPON WHICH IT IS FOUNDED, IN FAVOUR OF THE PRESUMPTION THAT THE NAMES ZION AND GIHON ARE AT PRESENT MISAPPLIED.

From the reiterated evidence in numerous passages hereafter cited, it distinctly appears that David dwelt in Zion : that it was the "city of David ;" that the Ark of the Covenant was brought to Zion ; that it was placed in Zion within a tent ; that the tent wherein the Ark was placed was within the precincts of David's house, for Solomon would not allow his Egyptian wife to reside in the house of his father David, because the Ark had been placed there ; that David's house was upon the same mount as the Temple of Solomon, but upon a lower level. It probably stood on the southern slope, in the quarter known as Ophel, spoken of in Chap. I., Sec. 1, as not

encircled by the modern wall, though pertaining to the ancient city.

We read, they brought the Ark "*up* by the stairs" to the Temple, from the place it had occupied in the city of David ; also, that the "Water-gate," which is elsewhere described as one of the gates of the Temple, was situated "*above* the house of David."

It therefore appears that the south-western hill, now called Zion, is erroneously so named, being higher than Moriah, the eastern hill upon which the Temple is *known* to have been erected.

The quotations also show that the Temple stood in Zion, for, among other proofs, the word "Sanctuary" is put in apposition with Zion ; that God was "dwelling" in Zion ; that in Zion was his "habitation ;" that the Lord's "fire" [*i.e.*, the fire upon the altar] was in Zion ; and that Zion was "the mountain of the Lord's house."

Nor is it astonishing that, after the desolation of the city by the Babylonians, and the scattering of the remnant of its inhabitants, on the return of the Jews many topographical records should have been lost, many localities forgotten, and the names of several places misapplied. Thus may be naturally accounted for the names Zion, Gihon, &c., having been misplaced.

Throughout the Old Testament the name of Gihon appears invariably to be applied to a portion of the Valley of the Kidron, adjoining the city; whilst Zion, as proved by the following extracts, must have been an appellation for the eastern hill:—

“David took the stronghold of Zion, the same is the city of David. . . . David dwelt in the fort, and called it the city of David.”—*2 Samuel* v. 7—9.

“Solomon assembled the elders of Israel. . . . unto King Solomon in Jerusalem, that they might bring up the ark of the covenant of the Lord out of the city of David, which is Zion. . . . and the priests took up the ark; and they brought up the ark of the Lord, and the tabernacle of the congregation, and all the holy vessels that were in the tabernacle, even those did the priests and the Levites bring up. . . . And the priests brought in the ark of the covenant of the Lord unto his place, into the oracle of the house, to the most holy place, even under the wings of the cherubims.”—*1 Kings* viii. 1—6.

“David took the Castle of Zion, which is the city of David. . . . David dwelt in the castle, therefore they called it the city of David.”—*1 Chronicles* xi. 5—7.

“David made him houses in the city of David, and prepared a place for the ark of God, and pitched for it a tent.”—*1 Chronicles* xv. 1.

“Solomon brought up the daughter of Pharaoh out of the city of David unto the house that he had built for her: for he said, My wife shall not dwell in the house of David, King of Israel, because the places are holy whereunto the ark of the Lord hath come.”—*2 Chronicles* viii. 11.

“They went up by the stairs of the city of David, at the going up of the wall, above the house of David, even unto the Water-gate” [of the Temple].—*Nehemiah* xii. 37.

“Yet have I set my King upon my holy hill of Zion.”—*Psalms* ii. 16.

"That I may show forth all thy praise in the gates of the daughter of Zion."—*Psalm ix.* 14.

"Oh that the salvation of Israel were come out of Zion."—*Psalm xiv.* 7.

"The Lord send thee help from the sanctuary, and strengthen thee out of Zion."—*Psalm xx.* 1—2.

"Out of Zion, the perfection of beauty, God hath shined."—*Psalm l.* 2.

"Oh that the Salvation of Israel were come out of Zion."—*Psalm liii.* 6.

"Praise waiteth for thee, O God, in Zion."—*Psalm lxxv.* 1.

"This is the hill which the Lord desireth to dwell in; yea, he shall dwell in it for ever."—*Psalm lxxviii.* 16.

"O God, . . . remember . . . this Mount Zion, wherein thou hast dwelt."—*Psalm lxxiv.* 1—2.

"God, . . . the Holy One of Israel, . . . he refused the tabernacle of Joseph: . . . but chose . . . the mount Zion, which he loved."—*Psalm lxxviii.* 41—68.

"Every one of them in Zion appeareth before God."—*Psalm lxxxiv.* 7.

"The Lord loveth the gates of Zion more than all the dwellings of Jacob."—*Psalm lxxxvii.* 2.

"The Lord is great in Zion."—*Psalm xcix.* 2.

"The Lord shall send the rod of thy strength out of Zion."—*Psalm cx.* 2.

"The Lord shall bless thee out of Zion."—*Psalm cxviii.* 5.

"The Lord hath chosen Zion; he hath desired it for his habitation. This is my rest for ever: here will I dwell; for I have desired it."—*Psalm cxxxii.* 13—14.

"The Lord that made heaven and earth bless thee out of Zion."—*Psalm cxxxiv.* 3.

"Blessed be the Lord out of Zion, which dwelleth in Jerusalem."—*Psalm cxxxv.* 21.

"They that carried us away captive required of us a song, saying, Sing us one of the songs of Zion. How shall we sing the Lord's song in a strange land?"—*Psalm cxxxvii.* 3—4.

"The mountain of the Lord's house shall be established in the top of the mountains. . . . Let us go up to the mountain of the Lord's house, to the house of the God of Jacob, and he will teach us of his ways : for out of Zion shall go forth a law."—*Isaiah* ii. 2—3.

"The Lord of Hosts, which dwelleth in Mount Zion."—*Isa.* viii. 18.

"Cry out and shout, thou inhabitant of Zion, for great is the Holy One of Israel in the midst of thee."—*Isaiah* xii. 6.

"The Lord hath founded Zion, and the poor of his people shall trust in it."—*Isaiah* xiv. 32.

"The place of the name of the Lord of Hosts, the Mount Zion."—*Isaiah* xviii. 7.

"Thus saith the Lord God, Behold I lay in Zion for a foundation, a stone, a tried stone, a precious corner stone, a sure foundation."—*Isaiah* xxviii. 16.

"The Lord, whose fire is in Zion."—*Isaiah* xxxi. 9.

"Look upon Zion, the city of our solemnities."—*Isaiah* xxxiii. 20.

"The city of the Lord, the Zion of the Holy One of Israel."—*Isaiah* lx. 14.

"To declare in Zion the vengeance of the Lord our God, the vengeance of his Temple."—*Jeremiah* l. 28.

"The ways of Zion mourn, because none come to her solemn feasts. . . . Her priests mourn."—*Lamentations* i. 4.

"He . . . slew all that were pleasant to the eye in the tabernacle of the daughter of Zion, . . . and He hath violently taken away his tabernacle; . . . he hath destroyed his places of the assembly; the Lord hath caused the solemn feasts and Sabbaths to be forgotten in Zion, and hath despised in the indignation of his anger the king and the priest."—*Lament.* ii. 4—6.

"Blow ye the trumpet in Zion, and sound an alarm in my Holy mountain. . . . Blow the trumpet in Zion, sanctify a feast, call a solemn assembly."—*Joel* ii. 1—15.

"I am the Lord your God, dwelling in Zion, my holy mountain. . . . The Lord dwelleth in Zion."—*Joel* iii. 17—21.

"Upon Mount Zion shall be deliverance, and there shall be holiness."—*Obadiah* 17.

“The Lord shall reign over them in Mount Zion, from henceforth, even for ever.”—*Micah* iv. 7.

“Thus saith the Lord of Hosts, I was jealous for Zion with great jealousy, and I was jealous for her with great fury. Thus saith the Lord, I am returned unto Zion, and I will dwell in the midst of Jerusalem: and Jerusalem shall be called the city of truth; and the mountain of the Lord of Hosts—[that is, Zion shall be called]—the Holy Mountain.”—*Zechariah* viii. 2—3.

Mr. Thrupp, in his learned work on the Topography, &c., of “Antient Jerusalem,” agrees with me that the modern Zion is not identical with that of the Old Testament Scriptures; but he differs from my views as to the locality of Gihon, and the part of the Temple Mount, or Zion, upon which the House of David stood: but as my object is not to establish any theory of my own, but to arrive at facts, I insert the section from his work *in extenso* which treats upon this subject, and in which his views are most ably set forward. But it appears to me that he has overlooked the force of the passage in which it states, they brought the ark “*up* by the stairs,” when conveying it from the House of David to the Temple; for the northern part of the Temple Mount was higher than the middle portion occupied by the Temple; and it does not by any means follow that they took the ark round the city in a procession to

bring it up by the stairs which were on the south of the enclosure.

Moreover, in the passage from 2 Chronicles xxxiii. 14, which says of Manasseh that "he built a wall without the City of David, on the west side of Gihon, in the valley;" that description would answer just as well to my view as to his; if not better, with regard to the locality of Gihon. It would be simply this, according to mine, that he built a wall on "the west side" of the Kidron, *i. e.*, "Gihon;" low down, *i. e.*, "in the valley;" to protect the houses, which, as I have endeavoured to show in Chap. I., Sec. 1, had probably extended far down the sloping side; and, consequently, that this wall was "without the City of David." In fact, it was built on the west side of the Valley of Gihon, and east of the City of David; separating the two; and protecting the latter, with its eastern suburbs. A reference to the Map will assist in forming a judgment. The wall of which we have been speaking probably nearly coincided with the outer wall in the time of Titus, as I have laid it down, marked on the Map by a distinctive character. It must be also borne in mind that "City of David" was a local appellation for a part only of Jerusalem. (See Thrupp's "Antient Jerusalem," pages 12 to 30.)

APPENDIX, No. V.

COTTON CULTIVATION IN SYRIA.

Abstract of a communication to Sir Culling E. Eardley, Bart., from Colonel Burnaby, Grenadier Guards, employed on Her Britannic Majesty's special service during the disturbances in Syria :—

“Beirût, April 8, 1861.”

“Dear Sir,—In consequence of the inquiries you made as to the growth of cotton in Syria, I have endeavoured to collect the necessary information, wherewith to furnish you with a sketch of its culture, &c., as now existent in the country.

“Both the Syrian soil and climate are pre-eminently adapted for the growth of cotton.

“From 480,000 to 600,000 lbs. are grown yearly, chiefly in the plain of Nablous. Its markets are, Damascus, the Lebanon, Hamah, and Homs, in which places it is likewise manufactured, for the most part being intermixed with wool or silk.

“The Syrian cotton is now sold at prices varying from 5d. to $5\frac{1}{3}$ d. per lb.

“In addition to the above growth, there is yearly imported from Egypt from 180,000 to 240,000 lbs. Its quality is, however, inferior to that grown in Syria; its price, after the payment of freight and custom duties, averages from $4\frac{1}{3}$ d. to $4\frac{2}{3}$ d. per lb.; it is used solely for the stuffing of divans and bedding.

“Several reasons have prevented the culture of cotton in Syria becoming more extensive. Few speculators have deemed it advisable to venture their capital under a Government they believe insecure to render them protection; nor as yet has any enterprising head been brought to bear upon the matter. The peasants themselves have seemed but little disposed, in their unaided condition, to take its cultivation widely in hand. The large landed proprietors are few; but nevertheless, in many districts, every male inhabitant may be said to represent, or he actually is, a small proprietor—holding or possessing, as the case may be, about 20 acres, upon which he grows from one to two acres of cotton; but even this he finds to entail trouble in disposing of, for the distant

market—transport in the country not being conducted in an organized manner.

“The great facility with which the peasant can prepare his ground for the cereal crops, renders him indolently disposed to bestow extra trouble on a plant, the fruit of which he finds it difficult to dispose of.

“As an example of the natural fertility of the Syrian soil, and the genial nature of the climate, I shall instance that, with no further trouble than the simple once turning over of the ground with a rude plough, and scattering the seed, a luxuriant crop springs up to ear in six or eight weeks; yielding, in wheat, 25 times the amount of seed, whilst barley produces 50, or even 80 times the quantity sown.

“Should it be the intention of any enterprisers to extend, or I may say establish, the regular growth of cotton in Syria for the home markets, the following information may furnish an idea of the steps to be taken for the rental of the land, the method of labour, and the protection they may expect to obtain.

“The Sultan (called Viceroy of God and Mahomet) had always been looked upon as the possessor of all land in the Ottoman Empire. On the disastrous results of such a system being re-

cognised by Sîlim I., he made certain concessions to the occupiers of land, without entirely giving up the rights of the Porte. These occupiers were suffered to become proprietors on the payment of a quit or crown rent. Since then, and under the present Sultan, Abdul-Megîd, the following come under the four principal classes of tenure, as established :—

“i. Land belonging to the Sultan or his Government, which, in consequence of not having been cultivated for the space of three years, or being for other causes confiscated, has been escheated. Such lands are called ‘Wâkûf.’

“ii. Land which is the property of the occupiers, and so insured by being entailed on private persons. Such are called ‘Wâkûf el Haramin.’

“iii. Land confided to the clergy, for the benefit of the church, or for remittance through them to private individuals. Such are termed ‘Wâkûf el Lûck-Rarah.’

“iv. Land settled, *ad infinitum*, on the eldest son, which cannot be parted with except by exchange. Such are termed ‘Wâkûf el Zirîyeh.’

“These are the heads under which land is held or possessed in the Ottoman Empire by its subjects.

“No Frank or European, who is not a subject, can become a proprietor ; but a provision has been made, in allowing Franks and others to hold land under long leases, or by special agreement, always provided that, as tenants, they agree to fall within the jurisdiction of the local authorities of the Porte, and have no recourse to the interference of their consular agents.

“The Government lands are, for the most part, rented by the year, by speculators, at a payment, in produce or its equivalent value, of about 10 per cent. The persons renting the land generally live near it, and sub-let it to the inhabitants of the neighbourhood, in farms, averaging 20 acres in extent. Each family of sub-tenants cultivates its own allotment, and pays to the speculator from 15 to 20 per cent. on the produce of the harvest.

“Systematic farming on a large scale may be said, in general, not to exist ; nevertheless, where it does, the following is the system under which it is worked : The large landed proprietor, or Crown tenant, furnishes the peasantry with land, seed, implements, and the use of the necessary yokes of oxen ; in consideration of which the latter undertake to supply all manual labour required on the lots confided to their trust,

and they receive 25 per cent. on the value of the harvest, either in produce or in money. From the 75 per cent. balance the Crown tenant, or speculator, pays the rent of about 10 per cent. to the Government, retaining for himself about 65 per cent.

“ With the exception of the property, or land-tax, which has to be fixed, no definite sum having been laid down, all districts vary their rate. Ibrahim Pasha instituted a personal tax, called ‘farde,’ which in these days has been altered for the present property or land-tax; each district calculated the total of what its personal tax had amounted to, and after ascertaining the extent of property situated within the district, subdivided the sum total, and transferred the tax from individuals to property, and hence arose a variable rate. One district happened to be extensive and thinly populated, whilst another was small and thickly inhabited.

“ Now, so long as property was equally divided among the people, and the population of each district remained the same, no great inconvenience ensued; but cases occurred which have been followed with much cause for complaint, and that without redress; for instance, at Sidon, when the property tax was substituted for the personal tax, the city happened to

be crowded with refugees from 'Akka' (St. Jean d'Acre); their share is now borne by the proper inhabitants of Sidon, who suffer the impost of at least 2 per cent. more than they ought. Sidon pays 10 per cent. property-tax, whilst Beirût pays only 6 per cent.

"I mentioned the subject of the cotton growing in Syria to Fuad Pasha a few days since, and alluded to the insecurity and distrust Franks felt in embarking largely in local commercial pursuits in Syria, with a view of ascertaining if terms which would inspire greater confidence might not be held out. He informed me that, so long as consular interference should not be had recourse to, he would grant lands on *long leases*, and protect all tenants under the laws of the Sultan as 'Rayas.'

"If nature were in Syria assisted by art, the fertility of the land would be productive of great results.

"Should any enterprising persons in England feel disposed to embark in the growth of cotton in this country, I should consider it a good speculation; and if, whilst on the spot, I could be of any assistance in the matter, it would afford me much pleasure.

"I would propose to them to have an agent in

the country, who could undertake the rental of the land with the local Government of the Porte, and be looked upon by it as the agent of the lands. He should live among the population inhabiting the district in which the plant should be grown, and himself furnish to the cotton-growers of the present system, above alluded to, that market of easy access which they desire.

“Such a person, as required, now happens to be in Syria, whom I can strongly recommend; his name is Mr. Whitty,* a gentleman of businesslike habits, and one who perfectly understands farming.

“I have no doubt that, if the regular growth of cotton were once established, its manufacture would proportionately increase among the people. In Damascus, before the late massacre, no less than 5,000 looms of silk, woollen, and cotton fabrics were daily at work; and at Aleppo about 2,000, of which 700 were used solely for the manufacture of British cotton twists.

“Believe me, my dear Sir,

Yours very faithfully,

“E. S. BURNABY.

“To Sir Culling E. Eardley, Bart.”

* Mr. Edward Whitty, the Author's brother.

APPENDIX, No. VI.

GENERAL AGRICULTURE IN SYRIA.

Abstract of a communication to the Syrian Improvement Committee from Mr. Edward Whitty, B.A., attached to Her Majesty's Commission in Syria, as Secretary to Colonel Burnaby:—

“ July, 1861.

“ 1. Leave will be granted by the Porte to select land anywhere, and in what quantities the English may wish.

“ 2. This land will naturally require large capital to work it profitably ; the capital to be supplied by Englishmen.

“ 3. All mines, minerals, &c., on the land will be secured to the Company, during their period of occupation, on the same terms as Railway Companies now existing in the Empire have got them.

“4. The land to be held under lease, as may hereafter be agreed upon; or, as I proposed to his Excellency Fuad Pasha, in a way similar to that of property purchased in Ireland by Land Companies, under the Encumbered Estates Court.

“5. The Porte will *guarantee* to the Company 6 per cent. interest on all capital invested. When more than 6 per cent. shall have been realised by the produce of the land, the Company are then to pay to the Government, out of the *net* profit above the 6 per cent., rent for the land—namely, the ‘*deeme*,’ or tenth.

“6. If the profits of the Company exceed 10 per cent., the Government are to get 2 per cent. in addition to the ‘*deeme*,’ but no more afterwards, even though the profits should reach 50 per cent.

“7. On the expiration of the term of occupation, the Company should *still* have a claim on the Government, who should be bound to repay them a certain portion of the originally-invested capital; such portion to be estimated by arithmetical calculation, upon principles to be originally agreed upon; allowance to be made for length of occupation, &c.

“8. The Porte will grant protection to the Com-

pany for life and property, but consular interference not to be claimed by them.

“9. The Company will be given the land for any description of agriculture they may wish. In my opinion, general agriculture, such as that carried on in England, would pay immensely.

“10. Most part of Syria is admirably suited for cotton. To the growth of this, if such should be their primary object, the Company could at first in a great measure confine itself, until the natives should have learned the proper method of cultivation, and the advantage it would be to themselves to grow it. The Company could then turn their attention to, in my opinion, the more paying occupation of general agriculture—a certain and a good market, the great desideratum in Syria, having been first established for the native growers.

“11. The best samples of cotton sent to Manchester from any part of the world have been grown in Syria, east of Jaffa, by the British vice-consul.* This alone will prove how suitable in soil and climate Syria is for the production of cotton.

“12. The plains of Syria, where cotton can be

* Dr. Kayat.

cultivated to advantage, are numerous and extensive. The vast plain of Esdraelon, extending from St. Jean d'Acre eastward beyond Mount Gilboa, a distance of more than thirty miles, by over eight in breadth, all extremely fertile and well watered.

"13. Further south, and eastward from Jaffa, is a fine plain, watered by the Aujeh and its tributaries, most fertile and suited for cotton. In corn the produce here is sometimes a hundred-fold, and by proper agriculture, from three to five crops yearly, as in Egypt, might be obtained.

"14. Northward are the plains of Homs and Hamah, with the Orontes running through them; the plain of the Būkâa, watered by the Litany; and the "Merj" of Damascus itself. I cannot say from personal knowledge if these are suited for cotton cultivation.

"15. North of Tripoli, from the mountain range to the sea, is a splendid plain, watered by numerous streams from Lebanon; it extends along the whole coast, from Tripoli to Tartûs, varying in breadth from one to six miles. Almost every portion of it would produce cotton; and all of it corn and other food. There is here at Tripoli a small harbour, where the produce of the land could be embarked for Europe.

“In the plain of Nablous, south of Esdraelon, about 500,000 lbs. weight of cotton is grown annually, and is sold at prices varying from 5d. to 5½d. per lb. Such cotton in England would fetch at least 9d. per lb.

“16. The great wheat-growing country of Syria is the Hauran and the south part of the plain of Sharon. The Būkâa supplies with wheat only itself and immediate neighbourhood; and Esdraelon only the surrounding mountains.

“17. A most eligible situation, so far as I can judge from the knowledge I at present possess, would be the plain mentioned in No. 15, for many reasons: First—There is in contemplation, by the Government, the formation of a road through it, leading to the sea-shore. (Such, at least, is Fuad Pasha's wish, who also has another very useful road in contemplation, from Aleppo to the sea.) Second—It is not subject to the raids of the Bedouins. Third—It has plenty of water. Fourth—It possesses a harbour convenient for export. Fifth—The French and Austrian mail steamers call there regularly. Sixth—It is reputed to be very healthy.

“18. Besides these, there are many smaller valleys and plains all through Syria, equally rich with those

mentioned above, but which should be selected by a person actually on the spot, travelling through them. Of the fertility of these no one at home has any idea.

“19. Independent of agriculture, there is another very profitable mode in which money might be safely employed in Syria by a company or individual capitalists—viz., in the purchase of private estates. As the law is at present acted on, no Frank [male] can *possess**

* This statement of my brother may be thus enlarged, by way of explanation. For many years Frank males have been the *real* but not *nominal* owners of property in the Turkish dominions; the title deeds being drawn up in the name of a subject, generally a servant of the purchaser; who, by a second agreement, acknowledges himself a debtor to his master to more than the value of the property; so that if he should assert his right to the estate, it could be immediately sold to another Turkish subject, and the price handed over to the Frank in part payment of his claim.

It has also been for a length of time permissible for women, although foreigners, to possess landed property under the Ottoman Government; therefore a European may purchase land to any extent in his wife's name. But these tenures not fully satisfying the English mind, an application was recently made to the Porte to allow male Franks to become the local owners of property in the dominions of the Sultan. The result was, the passing of the celebrated Hattıhamayoun, by which it was decreed that all foreigners, without distinction of creed or sex, or sacrifice of nationality, might, as regards property and religious rights, claim all the privileges of a Turkish subject; and for some little time this law was acted upon. But soon the cadhis, or local judges, received instruction from Constantinople to withhold their signatures from the transfer of land to male Europeans, without which title deeds are incomplete.

land in the Ottoman Empire ; but practically it can be done, and it is done, thus : By entering into partnership with a native or a naturalised subject. Numerous confiscated properties are at present offered for sale, but few persons there have any money to buy them. As an instance, one property, adjoining the city of Damascus, consisting of 1,000 acres of the best land in the world, abundantly watered by the Abana, was sold a few weeks ago for £600. Another eligible estate, of about the same extent, at Zebedâny, belonging to Mustapha Honasli (who was executed at Damascus), is to be sold ; it is eight hours' journey from Damascus, and for it has been offered only £580. There are hundreds of similar estates at present in the market. It would be well that some of these properties should be looked after.

“ 20. In Egypt, plain of the Nile, five crops annually can be obtained, and I see no reason why the same could not be done in the Syrian plains,

The “ Palestine Model Farm,” near Jaffa, was purchased in the name of the Rev. A. A. Isaacs, and the title made sure to the Association for which he acted, previous to this order. Dr. Barclay also told me, that at the same time he purchased some property in his own name at Jerusalem, and afterwards, when he wished to extend it, could only do so in that of his wife.

by irrigation and the use of foreign manures, guano, superphosphate of lime, crushed bones, &c. Bones, the best manure, can be had there in large quantity, at a low price, and the Company's agent might get them manufactured for manure upon the lands.

"21. A material point to be taken into consideration in the selection of land would be the probability of the existence of mines and minerals. I have reason to believe that silver and lead exist there, in what quantities I cannot by any means judge. Iron I know does, and coal likewise, but to what extent must yet be determined.

"EDWARD WHITTY."

APPENDIX, No. VII.

ACQUISITION OF LAND IN SYRIA BY AN ENGLISH COMPANY.

Important communication to Mr. Edward Whitty from Hassan Bey, Aide-de-Camp to His Excellency Fuad Pasha, Turkish Imperial Commissioner in Syria, and subsequently Grand Vizier :—

“Beyrout, May 20, 1861.

“Dear Sir,—I have had some conversation with His Excellency the Imperial Commissioner on the subject of the acquisition of land in Syria by an English Company for the purpose of cultivating the cotton plant. His Excellency is most desirous for the employment of foreign capital in the development of the great resources of these provinces, but there are certain objections to the granting of tracts of land to persons or companies retaining a right to the intervention of foreign agents in their relations with the Government of the country.

“There is at present in Turkey a considerable proportion of the population along the seaboard, which, although native by birth, is not Turkish by nationality, and its relations with the authorities are only by means of communications made through consular agents. This state of things causes continual embarrassment to the agents of the Government, which, I do not hesitate to say, finds itself continually engaged in rebutting unjust demands made on it by people who take advantage of the unfavourable prejudices which the irregularities and exactions until recently practised by many governors in the provinces have created in the minds of Europeans, and the over readiness of many consular agents to lend their support to almost any claim, without due inquiry into its justice.

“On the other hand, the recollection of vexations which formerly took place causes people still to desire to have a protection against their recurrence, however improbable or impossible they may now be. The consequence is, that in trade there is often a decided advantage in favour of the foreign trader over the native.

“The Porte thus sees its own subjects placed at a disadvantage, owing to the greater credit which a

prejudice, which should not now exist, gains for a foreign establishment.

“Now that Turkey has regular laws, and that no provincial governor, not even the Sultan, has power over the property of any one, no Turkish authority can acknowledge the necessity for this protection, and it is a duty to combat the want of confidence which the desire for it evinces. Fuad Pasha would not, therefore, favour the granting of lands to any persons or companies preserving a right to foreign protection as regards the land; for it must be recollected that a grant of this kind is an alienation of portion of the property of the nation. This is one of the reasons why the Sultan has abstained from confirming grants made by the Pasha of Egypt in favour of the scheme of the Suez Canal, that project comprising a right of colonisation.

“His Excellency is, however, most anxious to see Companies formed for the cultivation of cotton in these provinces, if their operations are carried on under the same kind of guarantee as those granted to Railway and other Companies, which are now in full activity, and in a prosperous state.

“I can indicate in a few words the terms on which a Cotton Company might carry on its operations in

this country. A guarantee of a certain per centage on its capital would be given. The employment of this capital to be entirely under the control of the agent of the Company, and all its operations and expenditure to be regulated by the Board of Directors. The works to be carried on precisely as the works of the Railway Companies now existing are, without any interference on the part of local authorities. Certain lands to be granted to the Company, for the purpose of cotton cultivation, in the same way as certain lands, and quarries, and mines have been granted to Railway Companies. The rent of the land to be a certain portion of the net profits, after the fixed per centage on the capital has been paid.

“A company investing capital on these conditions has nothing to dread. If the production does not give the profit expected, the Government will be still bound by its guarantee; and the prospect of partaking in a share of the profits, after they pass a certain amount, would induce the Government to favour and protect the agents of the Company in every way likely to facilitate the success of the enterprise.

“It would be well if agents of the capitalists who would be willing to enter into a speculation of

this kind would visit this country, to see the tracts of land which are available for the cultivation of cotton, to judge for themselves of the reality of the risk, of which so much is said, and to discuss in detail the terms upon which capital could be invested in this way.

“ I write these hurried lines at present, merely to let you know as soon as possible that it depends upon the people in England to cause thousands of acres in this country to be covered with cotton plants next year. At any distance from the coast, cotton has not hitherto been cultivated to any extent, because there is no market for it; and there is no market because transport costs so dear; yet there are many parts of this country which are passable for wheeled carriages, if such a thing as wheeled carriages were once introduced. A Company having capital at its disposal would not hesitate about creating proper means of transport; and this, along with the demand, would give an incalculable impetus to the movement in favour of the cultivation of the cotton plant, which it is so much the interest of the people in England to encourage.

“ As regards the chances of success of a Cotton Cultivation Company, the greatest proof I can give

of my belief of their being great is the assurance which I give you that the capital which I command will be willingly invested in any association of the kind which may be set on foot with a certain amount of capital subscribed.

“Believe me, yours most sincerely,

“HASSAN.

“To Edward Whitty, Esq.”

ADDENDUM.

Referred to in Chap. V., Sec. 1.

“The next point of interest in these recent discoveries [of Dr. Pierotti], is the secret passage which Herod the Great made, according to Josephus, for the purpose of connecting the fortress of Antonia with the eastern gate of the *inner* Temple—as the present text of the Jewish historian reads. Such a passage has been found by Signor Pierotti, extending from the Golden Gate in a north-westerly direction. But unhappily he has not been able to follow it along its whole length; only one section from the Golden Gate about 130 feet long, and another fragment of about 150 feet in length, being at present practicable.

“It is true that this would connect Antonia with the eastern gate of the *outer*, not of the *inner* Temple. But, in the first place, it is obvious that, if the passage

had been designed to communicate with the *inner* Temple, it would have run to the northern, not to the eastern gate, which was much more distant from the fortress ; and further, as one object of Herod was to provide for his escape into the country, in case of a sedition in the city, that purpose would not have been answered by securing a hidden access only to the gate of the inner Temple. When, then, it is considered that the change of a single letter would obviate these difficulties, and place the passage precisely where it is found, it is perhaps not taking too great a liberty with the text to propose to read τοῦ ἑξωθεν ἱεροῦ (the outer Temple) in the passage in question, instead of τοῦ ἑσωθεν ἱεροῦ (the inner Temple), as the text now stands.

“The course of Herod’s passage is of great importance for determining the position both of the eastern gate and of the fortress Antonia. It has been much disputed whether that fortress stood entirely without the present area of the Haram, or entirely within it ; or partly within, partly without. Light may be thrown on this question by an angle of massive masonry, which has been found embedded in the rock towards the north-west corner of the great court of the Mosque, between the raised platform and that corner which presents along its north side a wall

of solid rock rising to a height of from 20 to 25 feet. Indeed, the whole area in this quarter bears marks of the rock having been worked down to its present level by artificial means ; and corroborates the account given by Josephus of the operations of the Jews under Simon the Maccabee, after having driven the Macedonian garrison out of the castle built on the Temple mount by Antiochus Epiphanes. He tells us that they not only demolished the castle, but rooted up the very rock on which it was built, in order that they might never, for the future, be subjected to the like annoyance. It was a great work, and occupied them three years and six months, although they worked at it incessantly night and day.

“It is not likely, then, that this angle of solid masonry can have belonged to a building, not only destroyed to the foundation, but the very site of which was removed. It was more probably connected with the fortress Antonia of later times ; and, if so, may serve to explain a perplexing passage of Josephus, who, in speaking of the portents which preceded the destruction of Jerusalem, says that the Jews, by the destruction of Antonia, had made the Temple quadrangular ; while it was written in their oracles that the city should be taken when their Temple became

quadrangular. It is vain to inquire to what oracle he refers; but it is obvious to remark that Antonia was not demolished by the Jews, for there is constant reference to it during the siege of Titus. Josephus can only refer to the destruction of some part of the buildings of Antonia contiguous to the Temple, and projecting into the area, the demolition of which made the enclosure quadrangular. The massive masonry lately discovered probably marks the south-east angle of this projection.

“That the greater part of the fortress Antonia stood without the Temple Close seems to be proved by another important work which has lately been brought to light.

“This is a subterranean passage of noble proportions, partly cut in rock, and partly constructed of very solid masonry, which joins the Haram enclosure near the north-west angle, just east of the minaret, at a depth of about 20 feet below the surface of the rocky pavement of the court, or more than 40 feet below the upper surface of the wall of rock, which, as has been already stated, bounds the Haram in this quarter. The direction of this stupendous gallery is northward, bearing slightly to the west. It extends in length 224 feet, passing under the Via Dolorosa.

It is 22 feet wide, 29 feet high ; covered in at the top with long slabs of stone. There is a door in the side wall, 17 feet high and 9 feet wide, blocked up with solid masonry : and high up in the side walls a row of small openings, as for windows, which seems to be of later date than the gallery itself. Two narrower passages open out of the main vault, one running east, the other west. At the south end of the passage, where it joins the Haram enclosure, is an ancient door, now blocked up : but Signor Pierotti could discover no corresponding door in the rocky wall or pavement above, by which the vault might have had egress to the Temple Close. It is, therefore, very probably the entrance to Herod's secret passage, leading to the eastern gate already noticed, the direction of which, as far as it can be determined by the parts already explored, is towards this doorway.

“The great gallery itself must certainly have belonged to the fortress Antonia, or, perhaps, rather to its predecessor, the Baris, or castle of the Asmonean princes, as it answers very closely to the description of the dark subterranean passage which Josephus mentions as the scene of the murder of Antigonus by the guards of his brother, Aristobulus, under the tragic circumstances detailed by the historian. This

passage was called Strato's Tower, and was so closely connected with the Baris, that the sounds from the vault reached the ears of the high priest, Aristobulus, who was lying ill in the castle. It was doubtless a covered way designed to connect one part of the fortress with another, for greater security in the case of siege. A little beyond the northern extremity of this passage, but near the surface of the ground, Signor Pierotti accidentally tapped what appeared to be a tank of rotten water, but it continued to flow on, and has never ceased,* thus proving itself to be an aqueduct, probably part of that great work of King Hezekiah, recorded in 2 Chronicles xxxii. 3, 4, 30, and referred to in his eulogy in the Book of Ecclesiasticus, xlviii. 17.

* Though it appears the flow had not ceased before Dr. Pierotti left the city, which justified him in bearing away the impression that it was a constant stream, I can answer that it does not now flow. The tank, or saturated soil, which supplied the well has become exhausted, and the trickling from it when I was there, more recently than Dr. Pierotti, would scarce suffice to damp a piece of paper pressed with the hand against the place whence it oozed, a loosely-built partition wall, through which a stream might have forced its way whilst water remained at the other side. An account of the state in which I found it is given in Chap. V., Sec. 1. I went to see it in consequence of the triumphal announcement of the Jews, that living water had been discovered. This furnishes another proof that hasty conclusions should not be formed in such investigations.

“Another remarkable confirmation of the hypothesis that the fortress Antonia occupied the site determined by the subway just noticed, is found in the situation of the Roman arch, commonly known as ‘the Arch of the Ecce Homo,’ which spans the Via Dolorosa about 90 feet west of the point where that street passes over the subterranean gallery. It had long been doubted whether the arch in question was a Roman arch. That doubt has now been removed by the accidental discovery of the north side portal of the gateway. It had been covered for centuries by *débris*, and was accidentally brought to light by a landslip, occasioned by an excavation being made in the neighbourhood, for the foundation of buildings connected with the establishment of the ‘Filles de Sion.’ This portal is unquestionably of Roman workmanship, as is also the larger arch; and there was no doubt a corresponding portal on the south side, which may still be discovered. Thus the gateway would resemble those ancient arches which are still found in Rome, imitations of which were not unfrequent in the provinces—which also furnished models for Temple Bar and the Marble Arch.

“Such a gateway in this situation could be nothing else than the communication between the city and the

fortress Antonia, or the successor of that fortress, which may possibly have been erected when Jerusalem was restored by Hadrian, under the name of *Ælia Capitolina*.

“From this it results that the house of the Turkish Pasha occupies the site of the official residence of the Roman Governor, and that the barracks of the Turkish troops are in the same position as that occupied by the Roman garrison at the era of the Gospel narrative. Nothing changes in the East.”

GENERAL OBSERVATIONS.

The Lepers' Huts at Jerusalem should be removed from within the walls to a suitable place without the city ; as they are at Damascus. This would tend in good measure to a general improvement in many ways, by an increase of the respectable class of the population ; for, however much we may compassionate and are bound to aid these poor sufferers, we, who are, through the mercy of God, in other circumstances, should not like to place our dwellings in proximity to their miserable hovels, within hourly sight of those heart-rending objects, those shrunken, outcast creatures, as they crawl to and fro : and a clean, comfortable hospital outside, in the open air, would be more comfortable and healthy even for them.

Jerusalem suffers much from want of fuel ; even in February, March, and the early part of

April, it is cold in the mornings and evenings, owing to the elevation of the place, which is more than 2,700 feet above the level of the sea, though the heat of the sun is intense during the middle part of the day. Earlier in the season, at Damascus, which stands at nearly the same elevation, I experienced in a still greater degree the effects of cold, from a prevailing sharp wind during all hours of the day, when not exposed to the direct influence of the sun.

No coal has as yet been discovered in workable quantities in any part of Syria—though Ibrahim Pasha sunk a shaft in the Lebanon, and succeeded in reaching a small deposit—and the forests, which formerly were extensive, have in most places entirely disappeared. These causes render fuel dear and deficient in quantity, as well at Jerusalem as in all other localities in the land.

Faggots, composed chiefly of roots and branches, are conveyed from great distances, chiefly from Hebron and the banks of the Jordan, on beasts of burden, and sold in the market-place at so high a price, that they can be seldom used for any purpose but that of being converted into charcoal, and economically consumed in small pans for culinary

requirements; which is a great privation, as slight frosts are frequent, and ice an eighth of an inch thick occasionally occurs. Thorns, brushwood, and thistles, are almost the only fuel used in the baking establishments.

It would be advisable that all the summits of the hills below a certain elevation, and such other districts of the country as are suitable for timber, but not for cultivation, should be planted with cedar, fir, terabinth, oak, and other forest trees, which, if protected and duly replenished, would, in course of time, produce an abundant supply of fuel.

This also, by affording shelter, would increase the amount of moisture retained in the ground, and increase the supply for springs, &c., during summer time.

The planting of timber for fuel, &c., would be best effected under a Joint-Stock Company, who could afford to wait some years for a return on the capital invested.

Numerous large reservoirs should be constructed throughout the land, by placing barriers in suitable positions across the necks of valleys, to store up the winter rain for summer irrigation. Marshes should be drained, and poplars planted in

abundance, to furnish beams for houses, and for agricultural purposes.

Then Palestine would become, as formerly it had been, a fertile and a beautiful land; and in rendering it so, a field is presented for the remunerative investment, in agriculture, of the funds of a European Company.

Roads should likewise be constructed, to admit of wheeled vehicles conveying the produce of the country to Jerusalem, where a great national emporium ought to be established, and a ready market afforded for all products of the land—fair prices being given for all merchandise, &c., under a proper guarantee.

This would be the certain means of bringing Syria into a high state of cultivation, and developing its resources; and at the same time it might be rendered a profitable commercial enterprise.

The export trade and increased intercourse would require a harbour or a landing-pier at Jaffa, and a railway from that port to Jerusalem, and these would soon begin to pay interest on the outlay in their construction. Prosperity would then, indeed, have returned to Zion, and Christians and Jews both might equally rejoice.

I have examined the whole distance between Jaffa and Jerusalem, and find that there exists no engineering impediment whatsoever to prevent the two points being connected by a railway.

The sole difficulty to be encountered in the carrying out of this project for the regeneration of Palestine, and the profitable investment of European capital, is a disinclination on the part of the Ottoman Government to the granting of a Firman, with ample powers, rights, and privileges, under a sufficiently long tenure, to the Railway and Harbour Companies and the shareholders in the commercial enterprise; but this might, probably, be overcome, by setting on foot proper negotiations.

That I might be the better enabled to form a just opinion of the capabilities of Syria, by comparing it with a land of known utmost fertility, I visited Egypt, and can with confidence state that much of the productive soil there—that of average quality—is not superior to some of the Syrian plains; whilst the cost of artificial irrigation in such places as are not flooded by the Nile is much greater than in most parts of Syria, there being seldom any rain whatsoever in Egypt, except upon the coast, to fill upland reservoirs, which necessitates the irrigation of

all elevated land being performed by machinery or manual labour.

Volney well observes: "Syria unites different climates under the same sky, and collects within a small compass pleasures and productions which Nature has elsewhere dispersed at great distances of time and place. To this advantage, which perpetuates enjoyments by succession, it adds another—that of multiplying them by the variety of its productions. With its numerous advantages of climate and soil, it is not astonishing that Syria should always have been esteemed a most delicious country, and that the Greeks and Romans ranked it among the most beautiful of their provinces, and even thought it not inferior to Egypt."

I cannot close these pages without gratifying my own feelings by paying the tribute of a son's affection to the memory of my beloved father. In every page I wrote, the deep interest he took in all that concerned the Land of Promise recurred to my mind, and the happiness it would have been to him had he been spared to see the prospect of its speedy regeneration, as we now can behold it. He was to me a liberal and affectionate father, and to all who knew him a steadfast friend. His fatal illness was caused by over-fatigue in

the relief of the poor. The following lines, by H. M. White, were inscribed to his memory ; and I trust that when my two dear children, Robert Charles Irwine and John Edward, are old enough to read this, they will be thereby incited to follow in his steps, and, I trust also, take as deep an interest in the Holy Land.

“Inscribed to the memory of the Rev. John Whitty, M.A.,
Prebendary of Killenellick, and Rector of the Parishes of
Galbally, Ballingarry, and Ballylanders, in the Diocese of
Emly. November 19th, 1846 :—

“Yes, it is past—the final struggle’s o’er,
That manly, generous heart shall beat no more ;
Those eyes, where ever burned affection’s light,
And soft compassion beamed, are closed in night ;
That voice, whose tones could cheer the saddest heart,
No more can comfort to our souls impart—
For Death has triumphed, and we deeply mourn
The friend, the pastor, and the saint in turn.

“Who shall supply the prompt and vigorous mind
To plan, to execute, each action kind—
The widow’s help, the orphan’s steady guide,
The darling of his friends, his kindred’s pride ?
His Master’s glory first he ever sought—
His practice proving what his preaching taught ;
Zealous, yet careful never to offend—
The poor man’s comforter, the rich man’s friend.

“Why should our prayers all, all have been in vain ?
Oh, why the mastery should Death regain,

When, after days of anguish, hopes were high—
Hopes which, alas! were only raised to die?
Why not have swept some useless life away,
Nor sent to mingle with his kindred clay
The friend, whom sorrow but more steadfast proved,
The tender-hearted, loving, and beloved?

“Hushed be each murmuring thought—‘It is the Lord.’
Is not the labourer worthy his reward?
Why selfish mourn our friend to glory gone,
Tho’ we are left in sorrow and alone?
Death has not triumphed—hastily ’twas said:
No, Death is vanquished; for he is not dead—
Thro’ Jesus’ strength he vanquished in the strife,
And stingless death but ope’d the gates of life.

“Oh, may the mantle, which on earth he wore,
Of faith, of hope, of thoughts that heavenward soar,
Some other witness for the truth enfold,
Whom God shall send to keep His scattered fold!
And, as ‘the faithful fail,’ Oh, God, impart
His wisdom, zeal, and singleness of heart
To all Thy watchmen who on earth remain,
Till Thou, ‘whose right it is,’ shalt come to reign.”

Underneath was written, by “M. S.”:—

“These are high words of praise; but who that knew
The sainted subject, thinks them half his due?”





